Archaeological Investigations at Tobin Well: Adaptation in the Transition Zone

Archaeological Survey and Testing at the Hawk Radar Facility, Fort Bliss, Texas

by

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and

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Directorate of Environment
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This report details archaeological investigations for the Tobin Well project area located approximately 1 kilometer north of Biggs Army Airfield. Work involved survey, mapping, and subsurface testing of 1.08 square kilometers and subsequent analysis and write up of the collected data. Though the quality of the fieldwork was variable, analyses indicate a possible adaptive shift about A.D. 500 and peaking between A.D. 1100 and 1200. The possible cause of this shift is unknown, but it is suggested that climate, population increase, and other related variables may have played a role.

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Executive Summary

The Tobin Well archaeological project represents the results of a survey and testing project conducted in response to a projected land impact, the expansion of the Tobin Well Training Area, which will be used for training U.S. Army units in the Air Defense Artillery branch. The report, based on fieldwork conducted in the time period 1991–1993, contains a summary of the work done in previous projects, a description of the sites, the work done on them, and a statement on the National Register of Historic Places eligibility of each site. The sites were originally recorded by Whalen during his 1975 fieldwork in Maneuver Area 1.

The senior author, Chris Lowry, is to be commended for pulling together data from several projects and completing a report that helps Fort Bliss fulfill its obligations under the National Historic Preservation Act of 1966. The report is a useful addition to the body of archaeological knowledge that is accumulating about the Jornada Mogollon area.

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The authors of this report wish to thank the following people for their invaluable aid: Jerry William, Trace Stuart, Jeffrey Lee Johnson, Robert Merrill, Elia Perez, and Rich Stocker for their efforts in making this project work against all odds; Glen DeGarmo for the chance to prove ourselves; Joe Brandon, GRASS guru, for his help in producing invaluable map data; all the project directors for their help and support; Mark Bentley for his unflagging efforts to produce good work and keep the project on-track; Shane Offutt for his quick wit in times of stress and his tireless devotion to artifact analysis; Galen Burgett for helping me see things in a different light; all the other folks who contributed in one fashion or another; and finally a special thanks to Jeannette Lowry, wife, confidant, and part-time artifact analyst/editor who kept me going when I thought all was lost.

CHRIS LOWRY

Abstract

This report details archaeological investigations for the Tobin Well project area located approximately 1 kilometer north of Biggs Army Airfield. Work involved survey, mapping, and subsurface testing of 1.08 square kilometers and subsequent analysis and write up of the collected data. Though the quality of the fieldwork was variable, analyses indicate a possible adaptive shift beginning around A.D. 500 and peaking between A.D. 1100 and 1200. The possible causes of this shift are unknown, but it is suggested that climate, population increase, and other related variables may have played a critical role.

1

INTRODUCTION AND BACKGROUND

by

Chris Lowry and Jerry William

This study documents the results of Tobin Well Project (91-14) Phase I and Phase II cultural resource investigations at the proposed expansion area of the Tobin Well facility located on Fort Bliss, Texas. The U.S. Army uses the facility as a training area for the Patriot Missile Program and has determined that expansion is needed to meet demands of the system. The Tobin Well Project was designed to mitigate the Army's proposed impacts to this area.

Project 91-14 involved the survey of an initial 1.51-square-kilometer area north of the existing Hawk Missile Radar Facility. Surface collection and testing focused on 1.08 square kilometers of the initial survey area. Archaeologists assigned to the former Cultural Resources Management Branch (now Conservation Division), Directorate of Environment, Fort Bliss, Texas, conducted the project. Surface investigations resulted in the location of 48 archaeological sites. Subsurface testing was conducted on 16 of these sites and excavation efforts resulted in the collection of several thousand artifacts and the testing of several features.

Project History

The project area is approximately 1 kilometer north of Biggs Army Airfield near the existing Hawk Radar Facility (Figure 1.1). Before the current investigations, archaeological work within the project area was limited to surface surveys. Michael Whalen (1978) conducted an extensive archaeological survey of Maneuver Area I in 1976–77 and recorded 10 sites within the project area boundaries. During the fall of 1991 Fort Bliss archaeologists under the direction of Mark Bentley conducted Phase I investigations of Project 91-14. That survey recorded 39 archaeological sites including nine that Whalen recorded and 30 new ones. One site (41EP380) recorded by Whalen was not found during Phase I survey, but was rediscovered during Phase II. Another site, 41EP471610, was found, but had been destroyed by past Army activity.

In January 1992 the Army constructed a chain link fence around part of the project area. Several sites (41EP378, 41EP1605, FB6849, FB6850, FB8008, and FB10334) to the north and east of the project area were outside the fenceline and excluded from further study. The Phase II project area is entirely fenced and encompasses approximately 1.08 square kilometers.

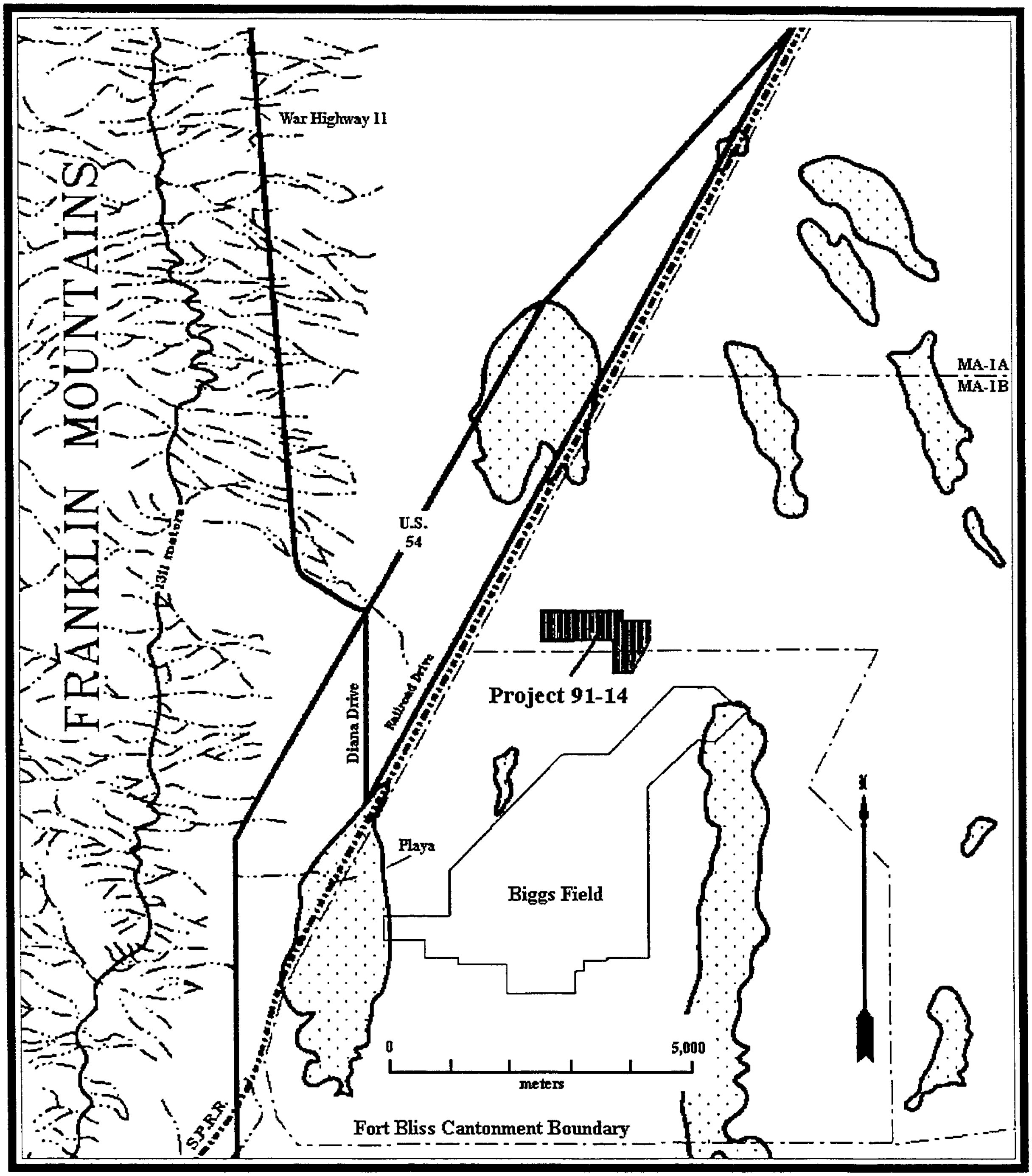

Figure 1.1. Project Location.

The exclusion of six sites reduced the number of project sites to 33. A further reduction in the number of sites came about when five Phase I sites were combined into two sites bringing the total to 28. Failure to find 41EP380 and the destruction of 41EP1610 reduced this number to 26. A reconnaissance of the area during Phase II resulted in the identification of 22 additional sites. These 22 sites plus the 26 Phase I sites brought the total number of archaeological sites for the project to 48.

Originally, Phase II of the project was to have surface collected and tested all sites within the adjusted project area. Phase III data recovery was planned for all sites after testing data had been compiled and evaluated. Modifications to this general strategy were incorporated into the work as needed during the field work phase.

Because of the discrepancy between the previous number of sites within the project area and the actual number found, the budget developed for mapping, collecting, and testing 22 sites was inadequate. Jerry William, the project director at that time, and Dr. Glen DeGarmo, Fort Bliss staff archaeologist, modified plans to continue intensive testing of as many sites as possible within the allotted time. Information from this work was to have been used to estimate what could be expected for untested sites. The other option was to try to test all the sites within the allotted time. This option would have limited testing at any one site and severely limited the value of data obtained for use in planning Phase III mitigation.

Phase II—mapping, collection, and testing of archaeological sites within the fenced part of the project area—began in March 1992 with a reconnaissance of previously recorded sites under the direction of Jerry William. The reconnaissance consisted of confirming the location of cultural materials recorded during the previous surveys. Some previously recorded field observations were not found and others were larger and more complex than originally recorded. Phase II crews also encountered additional sites. It became apparent that the project area contained many unrecorded sites and project planners decided that a reconnaissance of the area at 5-to-10-meter intervals was necessary.

Before Phase II site testing began, the Army requested that the western and southernmost parts of the project area be cleared for construction. To accommodate this request, sites 41EP1610, 41EP4703, 41EP4704, and 41EP4717 in the western part and sites 41EP4730, 41EP4731, 41EP4732, 41EP4734, and 41EP4735 in the southern part of the project area were tested, in some cases, extensively.

About midway through the Phase II fieldwork the Army informed DeGarmo that they needed only the southern and western sections of the project area for the expansion of the training facility. However, the project continued with the intent of gaining additional site information in the remaining project area in anticipation of later expansion needs.

Project plans were altered again and fieldwork was to conclude with the completion of Phase II in September 1992. The cost of extensive testing and excavation of sites was to come from the testing budget. Because testing all sites within the project area would have been impossible, project planners decided that testing should proceed on the sites in the easternmost part of the pro-

ject area where built-up sands would increase the chances of recovering intact cultural materials. Surface distributions in this area were not as well defined as in the western part of the project area and it was hoped that testing would give a better understanding of site structure.

William left the project early in 1993 and no further work was done until September 1993 when Chris Lowry was named project director. The final year of the project involved data analysis and report preparation for the 48 archaeological sites and the several thousand artifacts collected during Phase II surface collection and testing.

Research Perspective

To guide research at Tobin Well, project personnel decided that interpretation of the archaeological record examined during this project should not rely on past reconstructive efforts (that is, phase systems). Past research has treated the archaeological record as a time capsule containing single events or "little Pompeiis" awaiting discovery (Binford 1981). This is not the case. The archaeological record contains the sum of all discarded and lost materials over the landscape during long time spans, sometimes resulting in multiple deposits of material within a single area. The archaeological record is continuous over the landscape with some areas containing more material than others. Such a record is characteristic of the Hueco Bolson where erosion and deposition have altered most natural stratigraphy—and deposited younger artifacts on older surfaces containing older artifacts. Even stratigraphically segregated depositional units containing artifacts may have had repeated use in the prehistoric past for different activities, making traditional interpretation erroneous or impossible. Ebert (1992) reviews this phenomenon in depth.

Cultural resource management projects, regional surveys, and limited professional excavation have dominated research within the Jornada Mogollon region (Stuart and Gauthier 1981; Leach et al. 1993). This has led to an emphasis on explaining the cultural history of the Jornada Mogollon and narrowed research to settlement and subsistence (Beckes 1977; Whalen 1977, 1978, 1980; Hard 1983a; Mauldin 1986, 1993a, 1993b; Johnson and Upham 1987; MacNeish 1993). The problem is that no real advances in how or why prehistoric people did what they did have been made in more than 40 years. Though paradigms and approaches to archaeological interpretation have evolved through the years, the same basic cultural-historical sequence continues to guide interpretation. The problem is linked to archaeological methods that are unworkable in any real sense. If archaeologists approach defining the archaeological record in traditional ways, then it is virtually guaranteed they will find what they seek. Binford (1983) summarizes the direction archaeologists need to follow to understand the past:

> If we are not really historians or social scientists, what about the methods of the natural sciences? This is a rather more germane suggestion, for there is no expectation among natural scientists that their observed facts will "speak for themselves." Physicists, chemists, biologists, and so on, do not imagine that observed relations between

> things have meanings which are self-evident. They are continuously engaged in giving meaning to such observations and then evaluating how useful those assigned meanings actually are in practice. Surely, this is the position in which the archaeologist finds himself: giving meaning to the (contemporary) archaeological facts he observes and then trying to evaluate how realistic his picture of the past might be. It is for this reason that I have always advocated that archaeology should adopt the methods of the natural sciences. They are the only techniques of which I am aware that can help the archaeologist in his special and peculiar dilemma: the availability only of contemporary observations about material things whose causes are unavailable for observation (Binford 1983: 21–22).

The archaeological record, then, does not speak for itself. It does not provide the answers to how past peoples lived and developed. The archaeological record is a collection of static materials that archaeologists observe in the present. Binford states:

> The challenge that archaeology offers, then, is to take contemporary observations of static material things and, quite literally, translate them into statements about the dynamics of past ways of life and about conditions in the past which brought into being the things that have survived for us to see (Binford 1983: 20).

Thus, our task is to take the statics of the archaeological record (the things we observe today) and link them to the dynamic activities of the past (the things we want to know about yesterday).

It is perhaps more productive to view archaeology in the sense of having no preconceived notions of what took place in the past. Instead, there is a continuous record of use of the landscape through time. To deduce what took place on the landscape and why, archaeologists must look to not only past archaeological interpretations, but also ethnographic data for relevant behavioral interpretations:

> The object of "ethnoarchaeological" research, of course, is to seek a kind of control on the formation of the archaeological record. By living in a site and observing the various activities of its occupants, the archaeologist hopes to see certain archaeologically observable patterns, knowing what activities brought them into being (Binford 1983: 25).

From this point, researchers may pose questions to aid in interpreting the archaeological remains under study. One might argue that this approach is nothing more than fitting the archaeology into an analogic framework. That is not the intention. Instead, theoretical researchers garner questions and expectations from relevant sources, both archaeological and ethnographical, and analyze the archaeological data under study in the context of the research questions and expectations. If the data does not answer or provide more information regarding the proposed questions, then new questions must be posed or more data gathered. This method is how most "hard" sciences such as chemistry and biology approach interpreting their "universes." Rather than move from method to theory, archaeologists should move from theory to method (Ebert et al. 1983; Camilli et al. 1988; Ebert 1992). This research perspective also assumes that prehistoric peo-

ples and their cultural systems operated within the framework of evolutionry and ecological theory and, as such, are just like any other animal species living within such systems.

Thus, traditional methodologies are discarded in favor of an approach oriented more toward learning what the record can reveal about how prehistoric groups organized themselves via settlement, subsistence, and technology and how this organization is projected on the use of the landscape through time. Sites are analytical constructs given meaning by the archaeologist and introduce the assumption that people did things there and not at other places. It is more plausible to assume that people utilized all the landscape within a region and that this utilization resulted in the differential deposition of artifacts in all places.

Some artifact analyses reported herein used sites, while others examined entire artifact assemblages in hopes of defining past adaptive activities and landscape use. Though the use of "sites" can be questioned on methodological and theoretical grounds, they still have analytical utility.

The research domains (settlement, subsistence, and technology) are broad enough to allow interpretation of the Tobin Well data given the small area examined during the project. The hunter-gatherer model proposed by Binford (1980) and elaborated upon by others (for example, Kelly 1980) served as a basis for examining these research domains in more detail. Ethnographic information on southwestern and Great Basin groups living in similar environments provided further support. From these empirical generalizations, a theoretical outline (borrowed from Burgett 1994c) of archaeological expectations was generated. Pattern recognition studies conducted on the Tobin Well data ascertain if the theoretical expectations regarding site content and structure are correct. The results of this research may provide some important answers to the questions of prehistoric adaptations within the Hueco Bolson and surrounding regions, as well as provoke more questions about the nature of these adaptations.

Report Outline

This report contains 10 chapters and 3 appendices. The first chapter provides a background to Project 91-14. Chapter 2 provides a synopsis of the regional environment, both past and present; a description of the geomorphology and its potential effects upon the archaeological record of the region; and the changes within the local desert environment. Chapter 3 outlines the culture history and previous archaeological research for the El Paso region and critiques the use of past reconstructive efforts. Chapter 3 also provides ethnographic data, divided into three primary research domains, for groups that utilize environments similar to the Hueco Bolson and outlines theoretical expectations regarding archaeological site content and structure.

Chapters 4 through 8 present the Phase I and Phase II results. The fourth chapter briefly outlines the survey methods and results from Phase I survey investigations and provides an analysis of the survey results. Chapter 5 presents the results of the surface collection, as well as analyses and results.

Chapter 6 outlines laboratory procedures and discusses the analyses conducted on the Tobin Well ceramics. Chapter 7 outlines the methods and describes the results of chipped and ground stone analyses. Chapter 8 discusses subsurface data and the various features excavated and analyzed. Chapter 8 also looks at the results of specialized (chronological, faunal, and macrobotanical) analyses conducted for the Tobin Well project. Chapter 9 summarizes the combined results of the analyses and attempts to evaluate these results in light of the theoretical expectations presented in Chapter 3. Chapter 10 provides management recommendations for sites in the project area.

2
ENVIRONMENT AND GEOMORPHOLOGY

by

Chris Lowry and Mark Bentley

Project 91-14 encompassed an area of approximately 1.08 square kilometers along the western margin of the Hueco Bolson desert floor and a prominent alluvial fan of the Franklin Mountains (Figure 2.1). This chapter provides a summary of the environment and the geomorphology as it relates to the project and neighboring regions. The discussion focuses on landform and surface hydrological attributes prior to and resulting from historical development.

Modern Climate

Many detailed environmental summaries of the Fort Bliss area are available (Reynolds 1956; Jaco 1971; Orton 1978; Bradley 1983; Fields and Girard 1983). These studies show the El Paso region has warm to hot days, cool nights, and low humidity. Temperatures range from an average monthly high of 35.2°C in June to an average monthly low of 13.5°C in January. The frost-free period from March through October averages approximately 241 days per year.

Mean annual rainfall is approximately 20.1 centimeters, with more than half falling during July, August, and September. Highly localized thunderstorms characterize the weather during this period and intense cloudbursts often shallowly saturate soils. Much of the time, this rainfall only permeates the soils to a depth of approximately 5 centimeters and remaining surface runoff rapidly flows into nearby playas. During these events, the time sequence between upslope rains and downslope ponding may be as brief as 10 to 15 minutes (Bentley 1993). When unobstructed arroyos are swiftly transporting considerable amounts of mountain runoff, they also carry considerable amounts of sediment and debris, thus greatly increasing the destructive nature of these flash floods.

On average, the driest months of the year are March, April, and May, with less than 3 centimeters of rain falling during this period. Because precipitation during this time is less intense, runoff events are less common.

Rainfall in the El Paso region varies considerably from year to year. The wettest year on record is 1884 with 46.5 centimeters and the driest is 1891 with 5.6 centimeters (Jaco 1971). Low overall yearly rainfall totals, coupled with annual evapotranspiration rates averaging more than 200 centimeters, create a substantial surface water deficit throughout much of the year.

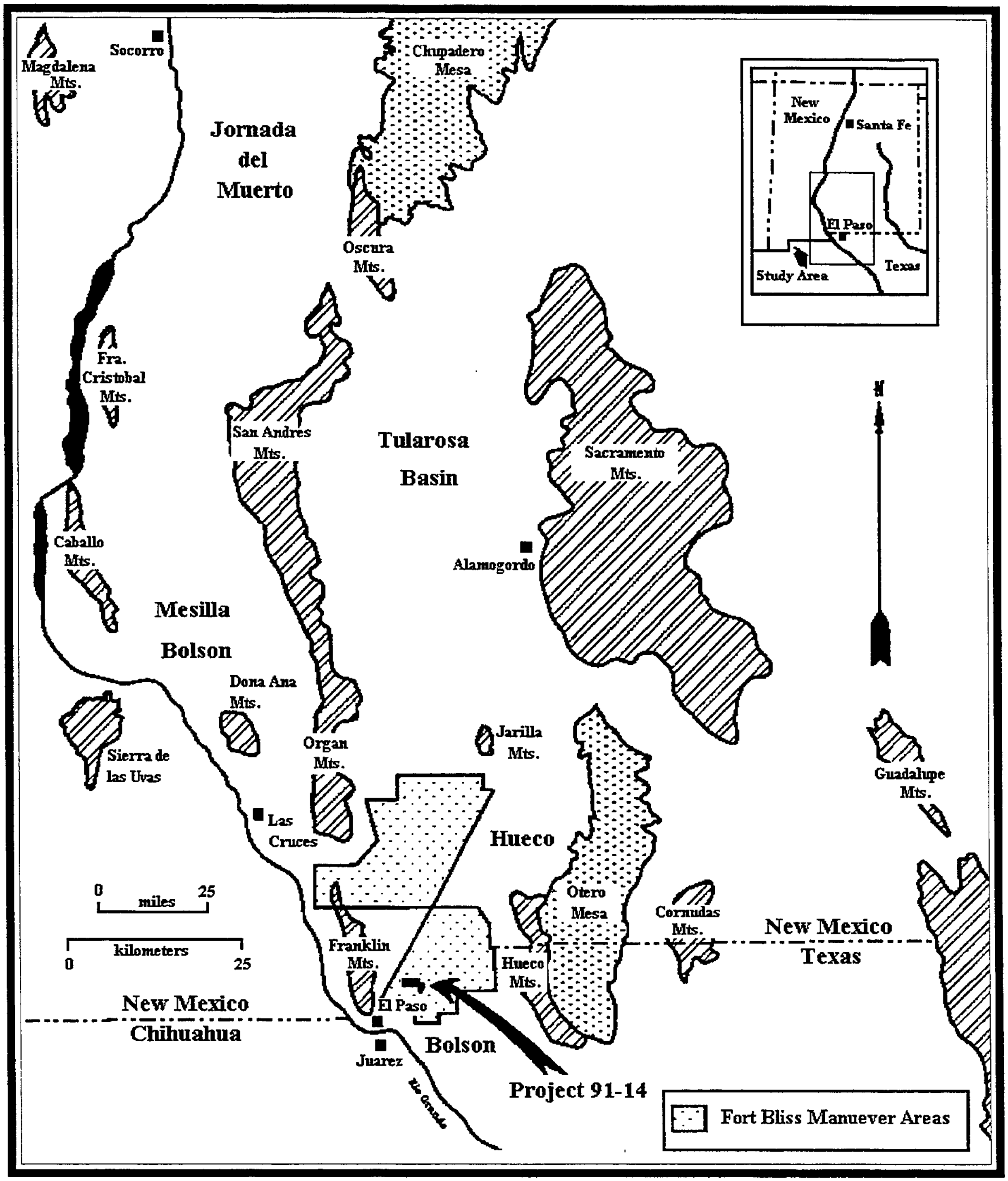

Figure 2.1. Regional Map.

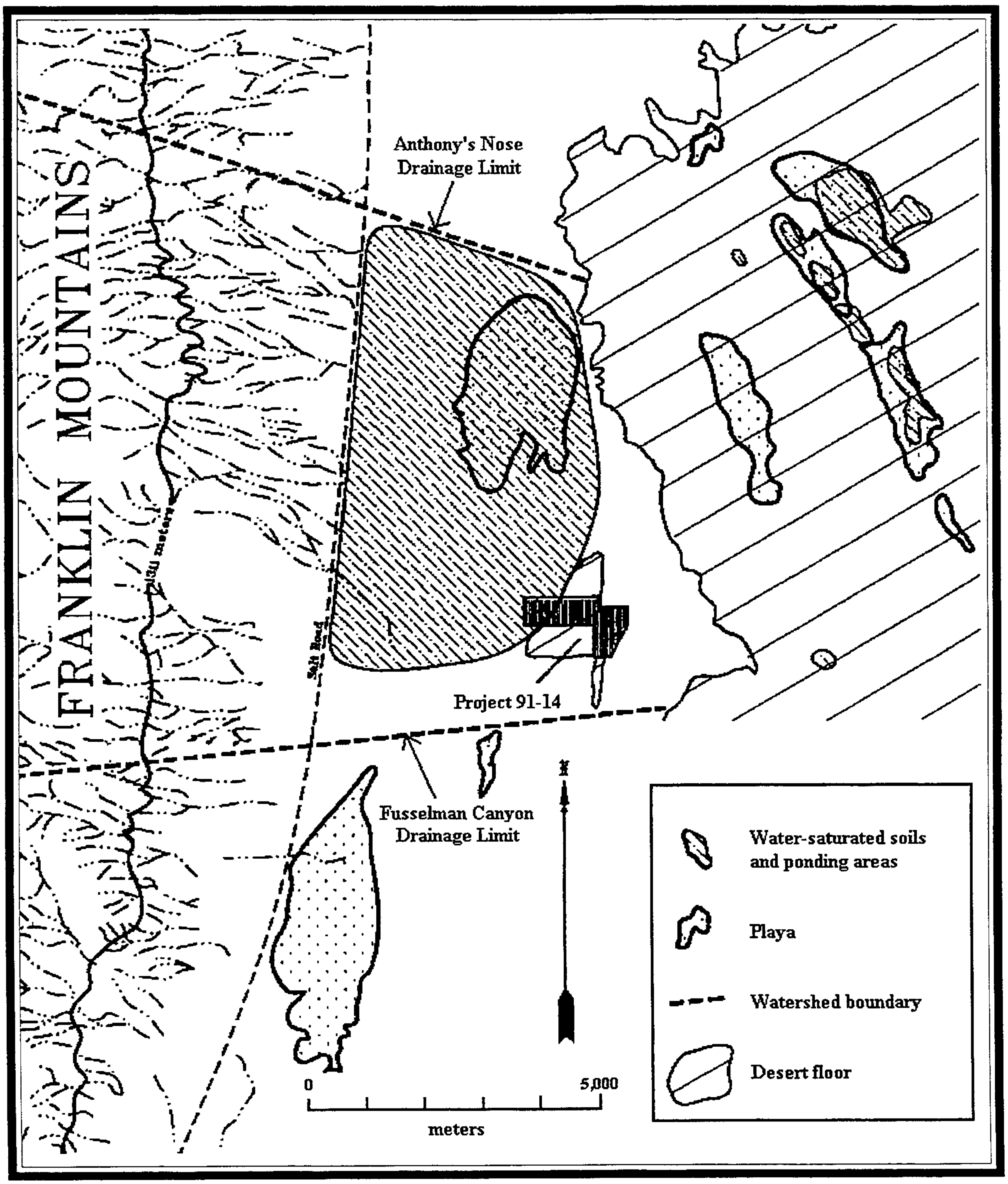

Figure 2.2. Fusselman Canyon-Anthony's Nose Watershed (1647–1896).

Physiography

The Tobin Well project area lies within the basin and range physiographic province known as the Hueco Bolson. The Hueco Bolson is an intermontane lowland that extends from south-central New Mexico, through West Texas, and into northern Mexico. The north-south trending San Andres, Organ, Franklin, and Juárez Mountains form the western boundary, and the Sacramento and Hueco Mountains form the eastern boundary. The only mountain outcrops within the central basin floor are the igneous Jarilla Mountains near Orogrande, New Mexico (see Figure 2.1).

Mesquite-stabilized coppice sand dunes, sand sheets (areas of eolian deposition), and blowouts (areas of erosional deflation) characterize the Hueco Bolson. Large and small shallow lakes or playas are scattered throughout the central basin and peripheries of the alluvial fans.

Playas temporarily fill with rain but, because of high evaporation rates, the majority rarely hold runoff from summer thunderstorms for any length of time. Prior to urban development, playas along the low gradient alluvial fans in the transition ecological zone received significant recharge from mountain watersheds (Bentley 1993).

Playas near the Franklin and Organ Mountains have held water for many weeks and occasionally months during the past 50 years. In an interview on 17 September 1989 Wadsworth F. Blythe of El Paso, a rancher whose family homesteaded a section of land north-northwest of the study area, recalled witnessing this occurrence since 1919. Locally, these playas include Coe, Quirk, Stewart, and Sherman Lakes. Even at distances away from the initial rainfall, ponding often results from upslope rains flowing down gradient. Additionally, water from intense overhead downpours ponds in playas. During the summer of 1968, ponded water from localized rainfall stood in Sherman Lake for two and one-half months without interruption. The playa potentially could hold vast amounts of water from rain falling in the immediate vicinity and alluvial fan runoff flowing along the Fusselman Canyon-Anthony's Nose watershed (Figure 2.2). Surface area of the playa at the 3,925-foot contour interval is approximately 5.1 square kilometers and its capacity for holding rainwater at this elevation is approximately 450,000 gallons. This assessment is based upon complete and immediate filling with no other variables considered. However, soon after the initial recharge, soil permeability and evapotranspiration rates reduce the volume of rainwater in storage. Therefore, progressively less water would have been available to the prehistoric people as more time lapsed between the initial playa filling and more rainfall.

In modern years the city of El Paso has used the playa as a borrow pit and modified it as a storm drain reservoir. Instead of torrential runoff flowing over the alluvial fan into this playa, canals and dikes divert runoff from buildings, streets, and parking lots into this ponding area. Today the playa safeguards nearby urban developments from floods.

Geomorphology and Site Formation

To better understand the processes that archaeological sites within the Hueco Bolson have been subjected to over the past 10,000 years, it is necessary to outline some of the geomorphological processes that have been aiding in the formation of and acting upon the archaeological record.

Eolian Geomorphology

Within the Tobin Well area, the primary geomorphological forces acting upon the archaeological record are eolian processes. Such processes create deposits and landforms by "the erosion, transport, and deposition of sediment by the wind" (Waters 1992: 185). Archaeological remains such as features and artifacts may be buried, preserving their context, or eroded, altering and sometimes destroying their context.

In general, eolian processes occur in arid to semiarid areas with a source of unconsolidated sediment, strong winds, and a lack of ground cover that would inhibit erosion (Waters 1992: 185). Wind may move particles of sediment from 0.1 millimeters to 0.84 millimeters. Smaller particles are usually more cohesive preventing their movement, while larger particles are too heavy. Larger particles, however, can be moved at lower wind speeds by impact of smaller moving particles (Waters 1992: 186). Three types of transport can move particles: suspension, saltation, and surface creep. Suspension transports small particles such as silt and clay by lifting them from the ground and blowing them for long distances. Saltation moves fine to mid-sized particles by hopping or skipping them in the direction of the prevailing wind. When particles drop they hit other particles displacing their positions as well. Nearly all sediments are moved in this manner. Surface creep moves particles slowly over the ground when saltating particles collide with heavier ground particles (Waters 1992: 186).

These three processes create a variety of landforms within eolian environments. Within the Hueco Bolson, the dominant landforms are dunes and lag pavements, dunes being the product of transported sediments and pavements the result of heavy gravels that cannot be moved by wind. The wind, then, can be an effective size sorting agent (Waters 1992: 187).

Because dunes cover most of the bolson, their formation is important. Dunes generally form when transported particles become trapped in natural obstructions such as banks or shrubs. As more sediments are trapped, a mound is created. The mound eventually develops a slip face (the side of the dune in the direction of the wind) and a backslope (Waters 1992: 187–188). The dunes in the Hueco Bolson are topographic dunes created around small shrubs or bushes. A low mound formed around the bush allows more of the plant to take root, which allows the dune to trap more sediment, and so on. Dunes created in this manner do not move and can grow to enormous sizes (some dunes in the bolson are more than 3 to 4 meters tall) (Waters 1992: 193–194). Interdune areas and sand sheets are also characteristic of the Hueco Bolson. Interdune areas are those places between dunes that lack vegetation and are usually of two types: deflationary and depositional. Deflationary areas are products of erosional processes; fine sediments are removed leaving heavier

particles such as coarse sands and gravels. Depositional areas are those that trap sediments through a variety ways such as wind or alluviation. Sand sheets are generally flat areas of deposition near dune fields and may mark the transition from eolian to noneolian environments (Waters 1992: 195).

Site Formation in Eolian Environments

Several factors can alter the primary contexts of artifacts and features in an eolian environment. Artifacts may become buried under or within sand dunes or exposed on the surface of dunes. Artifacts and features may also become buried (or exposed) in interdunal areas. Items that become buried by eolian processes may have their original context modified or destroyed. Artifacts may have been moved horizontally in the direction of the wind (or against the wind if falling down the face of a dune) depending on the size, shape, weight, surrounding soil matrix, and yearly weather conditions (Waters 1992: 196). Preservation of a site may only occur with rapid burial and stabilization after abandonment. If stabilization does not occur, primary context will be altered; artifacts may be deposited on one surface, buried, and then eroded down to an older surface containing older artifacts, mixing the contexts of both surfaces (Waters 1992: 196). Deposition may also affect site discovery. Sites may be buried under several meters of eolian sediment making them undetectable during surface surveys. Sites may also become buried and exposed many times due to movement of sand sheets and dunes. Deflation may remove lighter sediments, exposing larger gravels, artifacts, and features. Other mechanical processes may also allow artifacts to move upward within sediments as in the creation of desert pavements:

> When a gravelly deposit contains expandable clays such as montmorillonite, it expands when wet and contracts when dry. When expansion occurs, a stone is slightly lifted from its original position, creating a void under the stone. As the soil dries, the matrix around the stone shrinks, distorting the void. Because the shape of the stone no longer matches the shape of the void, it cannot fall back into its original position, and fine grained particles fill the void. The net effect is the *upward displacement of stones to the surface,* where they can concentrate to form desert pavement (Waters 1992: 205–206, italics added).

One other process that contributes to the alteration of the archaeological record is eolian erosion (sand blasting), which depends on wind speed, topography, vegetation, hardness of the abrading particles, and hardness of the surface being blasted. Such a process can erode walls and hearth features and scour lithic and ceramic artifacts (Waters 1992: 208–209).

The abovementioned processes, especially erosion, deflation, and the movement of buried materials, have important implications concerning archaeologists' attempts at interpreting the archaeological record. Cahen and Moyersons (1977) note that different lithic industries can be found within the different stratigraphic levels and that these levels have different radiocarbon ages consistent with the local chronology. Cahen and Moyersons state:

> [A] systematic study of the reassembly of the worked stones of Gombe (that is, joining together the tools, flakes, core and fragments struck

off from the same block) has shown that fitting artefacts were found at several different depths from which different radiocarbon dates have been obtained (the vertical distance between joining pieces sometimes exceeds 1 m) (Cahen and Moyersons 1977: 813).

Basically, Cahen and Moyersons conclude that vertical artifact movement is responsible for the fitted pieces found at different levels. Burgett (1994a: 3–5) documents the possibility of such vertical migration of artifacts within the Hueco Bolson where 1,000-year-old artifacts have been found on an estimated 100-year-old eolian surface.

Linse (1993), in a study of geomorphology and archaeological scale, found that geomorphological processes can alter interpretations of prehistoric cultural systems. She states that variables such as site size and artifact density frequently used in constructing cultural chronologies and site taxonomies can be biased by geomorphic processes like erosion, deflation, and deposition (Linse 1993: 16). The problem lies in the scales used in interpretation; archaeologists frequently operate at a much smaller scale than geologists. The solution lies in smaller-scale studies of the geomorphology and geology of archaeological sites. This would help determine if geomorphic processes influenced the sites and to what degree these processes altered the site size and artifact positions (Linse 1993: 25).

Blair et al. (1990) conducted an intensive geomorphological study of the GBFEL-TIE project area located on the western slopes of the Jarilla Mountains in terrain similar to that of the Tobin Well project area. They found that most of the archaeological record is concentrated within one stratigraphic unit—the Q3—and represents the accumulation of about 8,000 years of deposition. Very old (Paleoindian) material may be found at or near the Q2 and Q3 interface. They also found that wind erosion altered the depositional context of some portions of the project area. Lag layers containing larger gravels and, at times, artifacts are the product of such erosional processes. Lag layers also accumulate with arroyo and sheetwash erosion on the alluvial fans and near the edge of the basin floor (Blair et al. 1990: 203). They conclude that the project area has undergone "a repeated pattern of erosional stripping, active sedimentation, and sufficient landscape stabilization to allow soil development" (Blair et al. 1990: 200).

A strong possibility exists that the context of archaeological remains within the Hueco Bolson (and other eolian environments) is not pristine and that eolian processes have been at work modifying the context of artifacts and features since their deposition. Data from Tobin Well indicate a similar depositional history to that found by Blair et al. (1990) and Monger (1993). Knowledge of the stratigraphic units in which artifacts are found can give investigators clues as to how much the archaeological record has been altered and and allow them to take appropriate steps to control for these biases. Data from Tobin Well and other projects (see especially Doleman and Swift 1991) also indicate that intact, deeply buried occupational areas are present. Several variables, however, must be examined before finer stratigraphic control may be established.

Thus, the archaeological record of the region is not hopelessly muddled or de-

stroyed. Careful survey and excavation with attention to stratigraphic context can give the archaeologist and resource manager important information regarding the presence of intact deposits, as well as the nature of deposition and erosion for a given area.

Project Area

The Tobin Well project area is on the western edge of the Hueco Bolson desert floor approximately 8 kilometers east of the Franklin Mountains. The terrain is characteristic of the Mexican Highlands Section of the basin-and-range province of the northern Chihuahuan Desert. This region consists of north-south trending, late Tertiary period fault block mountain ranges separated by internally drained basins or bolsons.

The Hueco Bolson is bounded on the east by the Hueco Mountains and on the west by the Franklin Mountains. The desert floor extends north to the New Mexico-Texas state line and south into Mexico. The northern part of the bolson is internally drained, and surface and subsurface runoff in the southern part discharges into the Rio Grande floodplain.

The project area lies within an area defined by Whalen (1977, 1978) as the transition zone, an area characterized by diverse soils and fairly abundant water. In fact, aside from mountain springs and the Rio Grande, the transition zone contains the most readily available water during certain times of the year. This is especially true with seep springs at the higher elevations and sheetwash flowing into the myriad playas at the lower elevations.

Soils, dominated by the Turney-Berino Association (Jaco 1971), are deep and moderately permeable with a high water retention capacity and slow runoff rate. Such areas are ideally suited for farming. Creosote bush dominates the upper edge of the transition zone and mesquite, yucca, and snakeweed dominate the lower periphery.

The project area slopes gently to the west-northwest and drains into a low lying area near the foot of the Franklin Mountains. Project area elevations range from 3,915 to 3,950 feet above mean sea level. Two microenvironmental zones within the project area, the dune zone and the grassland zone, appear to correlate to archaeological visibility and preservation.

Large mesquite-anchored coppice dunes and dune fields with deeply scoured interdunal blowouts (dune zone) characterize the western half of the project area. Nodules of caliche and lag gravels from the ancestral Rio Grande cover the surfaces of the blowouts. Thin layers of recently deposited eolian sands anchored by broom snakeweed cover the blowouts in some places. The dune zone contains much evidence of past military activity and vehicular traffic. Military refuse is scattered throughout, and both wheeled and tracked vehicles have maneuvered through most blowouts. These exercises may have accelerated erosion of the landscape in this zone.

Due to the amount of erosion and lack of dense vegetative ground cover, archaeological visibility is high in the dune zone, and most archaeological remains in the area appear to be part of lag deposits that have accumulated in the blowouts. Preservation of artifacts in these areas may be variable.

Some artifacts may have been deposited on a higher surface that has eroded, leaving them on a lower surface. Other areas may have had artifacts deposited directly on the eroded surface indicating an intact deposit. Dunes and sand sheets may have buried artifacts as well.

A fairly stable landscape with deep deposits of eolian sand characterizes the grassland zone. This zone is present throughout most of the eastern half of the project area and, in general, contains a fairly dense ground cover of grasses, broom snakeweed, and various annuals and perennials that anchor the sand. Other vegetation consists of four-wing saltbush, allthorn, sand Mormon tea, soaptree yucca, and honey mesquite. Only a few mesquite-anchored coppice dunes are present in this zone. Some of these dunes and the larger allthorn bushes have adjacent shallow depressions. It appears that past military activity in the grassland zone, especially vehicle traffic, has been minimal, although the active nature of the eolian sand may have obliterated most traces of past military activity. Some military refuse is present on the ground surface and very few vehicle tracks are visible in the wind blown sands.

Due to the apparent stability of the ground surface, the presence of dense ground covering vegetation, and the accumulation of eolian deposits in the grassland zone, visibility of cultural materials is low. Throughout the majority of this zone, archaeological materials are visible only in the deepest deflations, mostly around dunes and allthorn bushes. Rodent activity, which appears to be concentrated in these areas, also has brought buried cultural material to the surface. Therefore, site boundaries based upon surface distributions in this zone are tenuous at best.

Conversely, the preservation of cultural material in the grassland zone is very good. Archaeological testing revealed the presence of intact deposits and features buried at depths of at least 50 to 60 centimeters below the present ground surface. It may be that low spots within the grassland zone, which generally contain most cultural material, are undergoing the process of erosion and dune formation. If these low areas are uncovering artifactual material, areas that contain no surface artifacts are likely to contain buried deposits. A more extensive stratigraphic and geomorphological study would have to be undertaken to determine this.

Stratigraphy

Several authors (Jaco 1971; Pigott 1978; Hubbard 1988; Monger 1993) describe the various soils in the Hueco Bolson (Figure 2.3). Sheet and dune sands characterize the Hueco-Wink Association, which dominates most of the bolson. Clay contents of coppice dunes range from approximately 30 to 40 percent. Playas generally have much higher clay content, often approaching 90 to 95 percent. This results in higher moisture retention for saturated soils. As such, soils near playas may have been ideally suited for agricultural pursuits.

The Project 91-14 research area contains five documented major soil strata. The most recent is historic blow sand, followed by Organ III, Organ II, Organ I, and La Mesa soils in order of latest to earliest deposition (Figure 2.4).

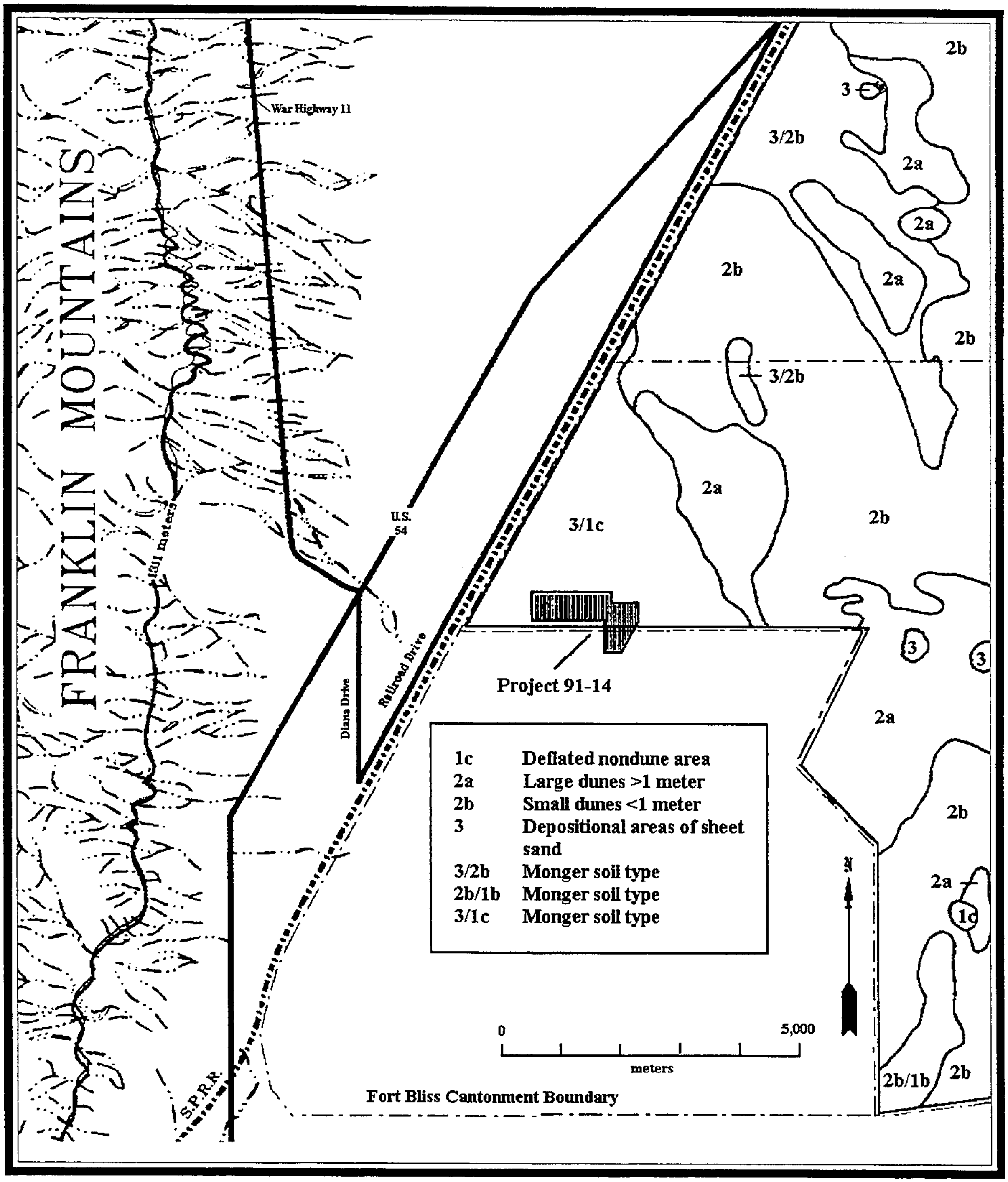

Figure 2.3. Soil Types near the Project Area (after Monger 1993).

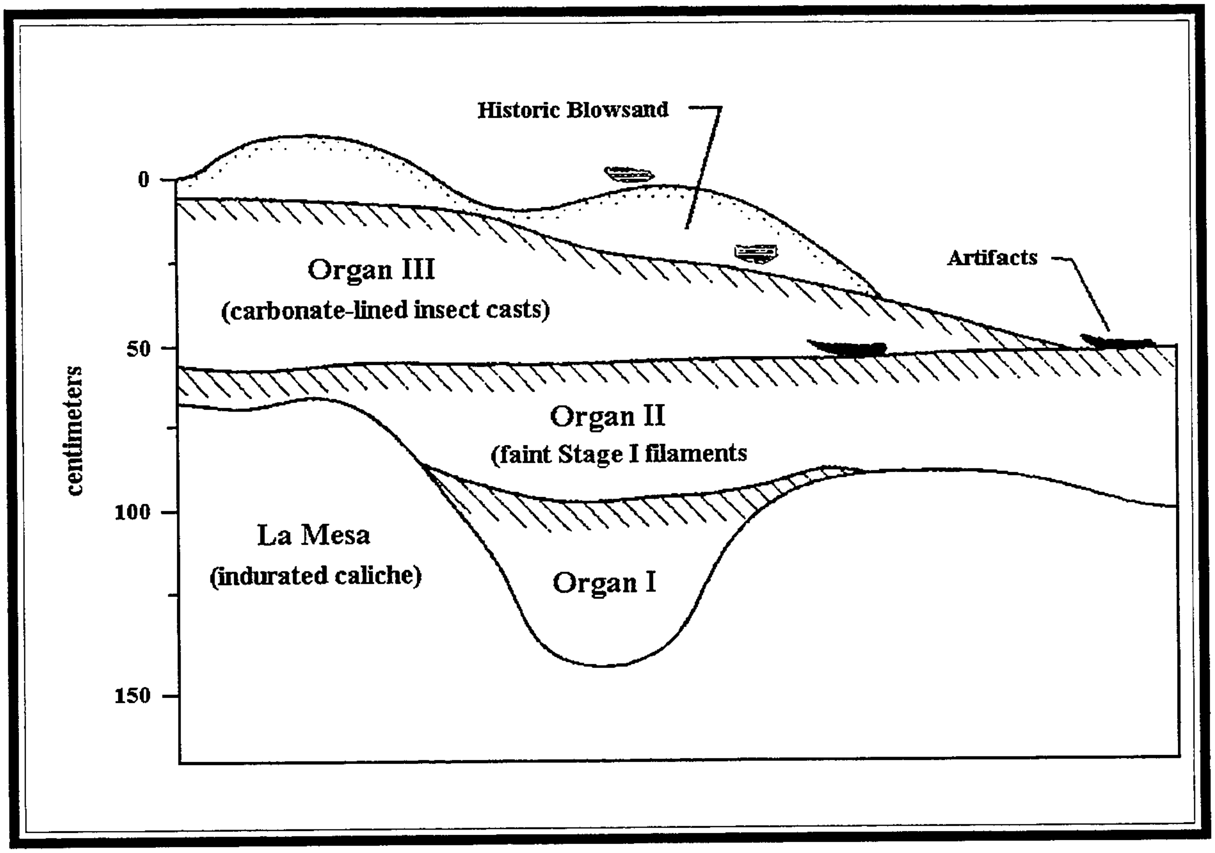

Figure 2.4. Stratigraphic Profiles Illustrating Major Soil Units at Tobin Well Site 41EP4731 (Monger 1993).

Historic blow sand consists of recently deposited eolian sands that range from 1 to more than 50 centimeters in depth within the project area and are believed to be approximately 100 years old (Monger 1993). This stratum consists primarily of subrounded to rounded grains of quartz less than 1 millimeter in diameter. The surface of these deposits is usually very loose and light brown in color, but becomes more compact with increasing depth. Most cultural material is found in abundance on the surface and within this stratum.

The Organ III stratum consists of slightly compacted to compacted loamy sand up to 50-plus centimeters thick and ranges in age from 100 to 1,100 years. There is always a distinct break between the blow sand and the Organ III stratum indicating that the top of the stratum represents an erosional surface. Three subdivisions (Organ IIIA, Bk, and C') exist within this stratum. Organ IIIA is a darker, organic-enriched layer that is more compacted than layers above and below. Carbonates are not visible in this stratum, but it effervesces strongly with the application of hydrochloric acid. Organ IIIBk is reddish brown in color and has carbonate-lined insect casts and root remnants. It effervesces slightly when tested with hydrochloric acid. Organ IIIC' is very faint and not distinguished in profiles. In this stratum no carbonates are visible, and testing with hydrochloric acid produces no effervescence (Monger 1993). Cultural material also is

present within this stratum, as are most features, but artifact densities are generally lower.

The Organ II stratum has no substrata, is up to 35-plus centimeters deep, and ranges in age from 1,100 to 2,100 years. Light colored loamy sand that is more compact than the Organ III stratum characterizes this stratum. The top of the Organ II surface represents an erosional surface. Organ II contains Stage 1 filaments and carbonate-lined insect casts and root casts (Monger 1993). Buried cultural deposits and features are found within this stratum, but are generally few.

The Organ I stratum contains higher levels of carbonates that are visible throughout the soil and along pedologic lines when the soil is broken. This stratum ranges in age from 2,100 to 7,000 years (Monger 1993).

The La Mesa surface is an erosional stratum characterized by a very light brown sandy loam dominated by Stage II and III caliche nodules, with the caliche becoming indurated with increasing depth (Monger 1993). The La Mesa stratum is usually below occupational levels in the project area although some features are excavated down to or into this layer of caliche.

Flora and Fauna

A wide diversity of flora and fauna, all of which are found in prehistoric site contexts, inhabit the El Paso region. Several authors (O'Laughlin 1978; Hard 1983b; Anderson 1993; Bentley 1993) provide summaries for the periods of resource availability throughout the year.

Primary animal resources available in the El Paso region include mule deer (*Odocoileus hemionus*), pronghorn antelope (*Antilocapra americana*), cottontail rabbit (*Sylvilagus auduboni*), and jackrabbits (*Lepus californicus*). Floral resources that have a potential use for food, fiber, and wood include lechuguilla (*Agave lecheguilla*), sotol (*Dasylirion wheeleri*), mesquite (*Prosopis juliflora*), yucca (*Yucca elata*), sage (*Artemisia filifolia*), snakeweed (*Xanthocephalum sarothrae*), creosote bush (*Larrea tridentata*), and a variety of grasses and forbs.

Within the Hueco Bolson, mesquite and broom snakeweed associations predominate. Other plants found within this area include yucca, four-winged saltbush (Atriplex canescans), and a variety of grasses and forbs. Animals observed during the fieldwork included jackrabbits, cottontail rabbits, mule deer, and a variety of small rodents.

Paleoenvironment

Information about the paleoclimate of the region comes from palynology and the analysis of pack rat middens. The information presented herein is not intended to aid in reconstruction of past cultural systems, but is presented to aid in understanding past climate systems and their dynamic nature. A more in-depth review of past paleoenvironmental work within the region can be found in Carmichael (1986).

A pollen study by Freeman (1972) in Doña Ana County shows a mesic period from approximately 5000 to 2200 B.P. A dry period is present until about 1100 B.P. and mesic conditions appear to have returned after this date.

Pollen work near the project area includes Dean's (1989) study from the Loop 375 project that suggests mesquite pollen first occurs in samples that may date to the middle to late Holocene. Mesquite pollen is rare in early Holocene samples. Dean also notes that grass pollen (Cheno-am) is more prolific at increasing depths in the pollen profiles. Horowitz et al. (1981) also report high levels of grass pollen during the early prehistoric period. Clary and Dean (1991) found that pollen recovered from archaeological contexts is likely to be rare. Their study could not identify enough pollen from various contexts to make any definitive statements indicating what past climates may have been like. Gish (1993) suggests that a semidesert grassland existed in the late Pleistocene and changed to a more desert scrub regime in the Holocene.

Pollen studies appear to support analyses of pack rat middens by Van Devender and Spaulding (1979), Van Devender and Toolin (1982), and Betancourt et al. (1990). Pack rat samples from the Hueco Mountains and surrounding areas range from the late Wisconsin period to the present. Pinyon, juniper, and oak dominated at the end of the late Wisconsin (circa 11,000 B.P.). During the early Holocene the climate seems to have become xeric with pinyon on the decline and mesquite on the rise. By the late Holocene (circa 4000 B.P.) the modern environment began to develop with the appearance of creosote, mesquite, and several types of succulents. The overall climate of the region appears not to have changed since the Chihuahuan desert scrub became dominant.

Historical Effects

Sherds from a small early Historic period jar found during the initial survey of the project area provide limited evidence of Spanish or Mexican use of the grasslands near the project area.

Beginning in the seventeenth century and becoming more common during the twentieth century, upslope alterations to the watershed transformed the project area. Urban growth and intensive construction modified the natural geomorphological processes that once supported prehistoric populations in the area. Some modifications have been minimal and other impacts have altered the flora, fauna, and topography to such a degree that preexisting conditions can never be replicated. It may be of interest for future researchers to compare the observations presented in this study with conditions in the project area in the middle to late twenty-first century. If current patterns persist, the encompassing grasslands of Project 91-14 may be covered with mesquite and mesquite dunes.

To ranchers in the late nineteenth century, the grasslands in the project area were very attractive for grazing horses and livestock. In anticipation of large financial gains, they loaded the lush grasslands with cattle during the period around 1884, the wettest year on record. A regional drought in 1891 resulted in the lowest rainfall on

record. Cattle overgrazed the grasslands during the drought and set in motion the conditions seen in the landscape today (Hennessey 1981; Gibbens et al. 1983). Rainfall trends in the latter nineteenth century, coupled with overgrazing, affected the reduction of grasslands and expansion of mesquite in the region.

The late nineteenth century saw an increase in grassland erosion and subsequently an intrusion of weedy plants such as mesquite. Though mesquite was present as early as 8000 B.P., the large mesquite dunes so characteristic of the area may be relatively recent in origin. Research by Buffington and Herbel (1965) at the Jornada Experimental Range in southern New Mexico, suggests that in 1858 mesquite covered less than 5 percent of the range. By 1963 this figure increased to 45 percent. Additionally, vegetation changes monitored at the Jornada Experimental Range between 1935 and 1980 indicate that heavy cattle grazing coupled with drought conditions further depleted the grasses and created conditions for mesquite and mesquite dune encroachment. The result was a 75 percent reduction of the perennial forb species between 1935 and 1980 (Hennessy 1981; Gibbens et al. 1983).

Mesquite encroachment also is documented in archaeological contexts within the Hueco Bolson. At the Hot Well Village along the eastern margin of the desert floor approximately 30 kilometers east-northeast of the Tobin Well Project area, large coppice dune mesquites cover at least two Pueblo period floors. Excavations between 1929 and 1980 removed many other mesquite-stabilized dunes. Additionally, within the past century, mesquite has intruded along the alluvial fan near the southern part of the site and now grows in coppice dunes that cover the sands and clays on the alluvial fan. Cattle overgrazing, drought conditions, dirt roads, and trails attributed to the depletion of the grasslands and the profusion of mesquite in the Cerro Alto watershed around this village. Today, dirt roads effectively form aqueducts channeling the natural flow of mountain and alluvial fan sheetwash and leaving a large water deficiency to the alluvial fan soils downslope, thus allowing for the expansion of mesquite (Bentley 1993).

In the Tobin Well Project area, a similar invasion of mesquite is demonstrated graphically by comparing the ratio of mesquite to grasses clearly visible on high altitude 1:25,000-scale aerial photography flown in 1944 and more recent 1:3000-scale aerial photographs flown in 1976 (Figure 2.5). Depletion of the grassland and intrusion of mesquite around the project area may be due to recent phenomena.

Changes to the landscape of the project area are the result of many historical events. The first that affected the study area occurred after 1647 when the Spanish Salt Road was founded (see Figure 2.2) to provide a route that joined the Camino Real at present-day Juárez, Mexico to the saline deposits in the northern Tularosa Basin (Bentley 1991). The creation of this low gradient road had a slow but influential effect on the landscape. Besides its use as a shipping lane, this centuries-old road was the main route of passage for most people traveling throughout the intermontane desert region between 1647 and 1938. The more the road was traveled, the deeper its wheel ruts became and the more numerous its parallel wet-weather tracks scored the terrain. This resulted in more mountain alluvial fan runoff being redirected from the watershed downslope.

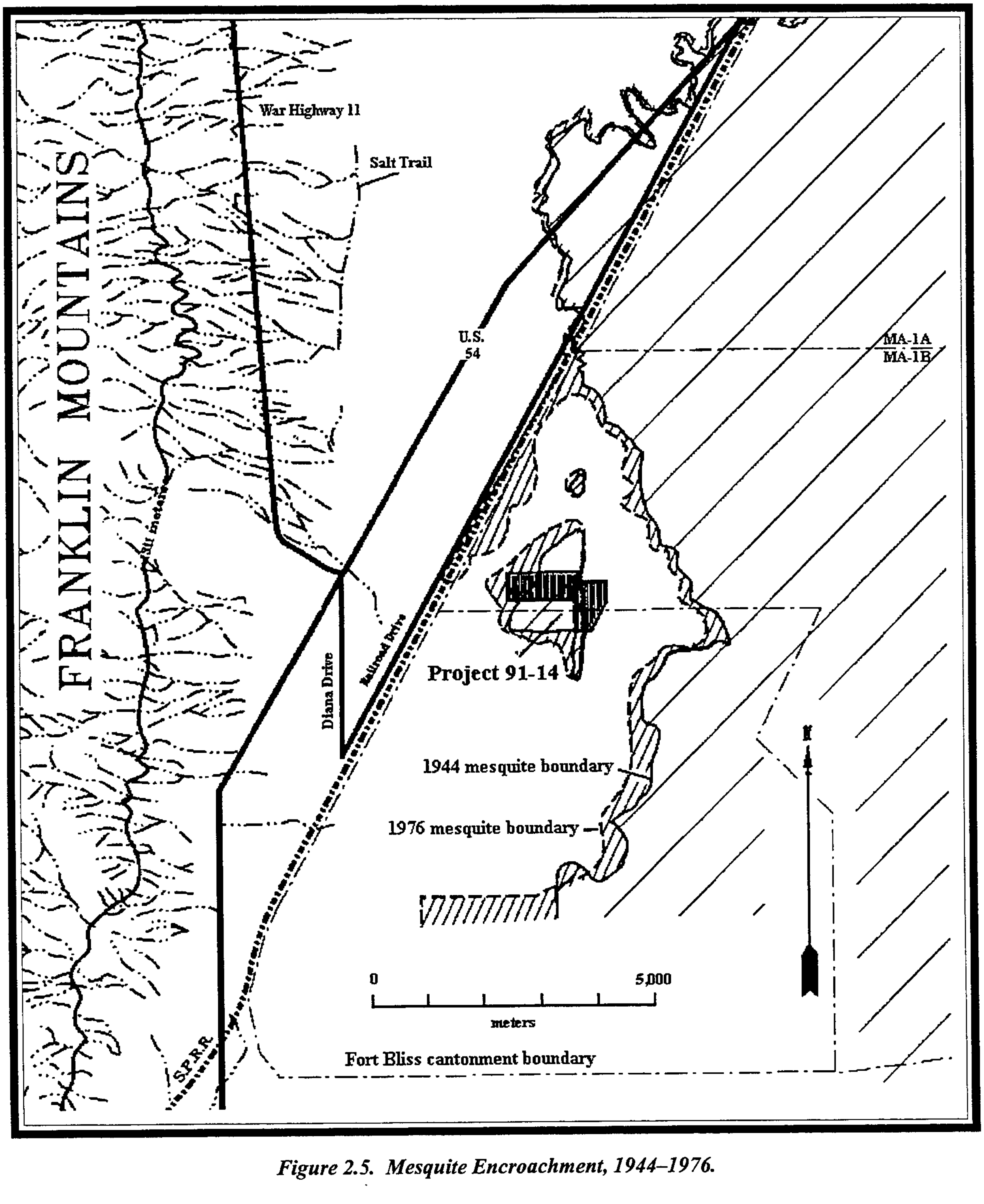

Figure 2.5. Mesquite Encroachment, 1944–1976.

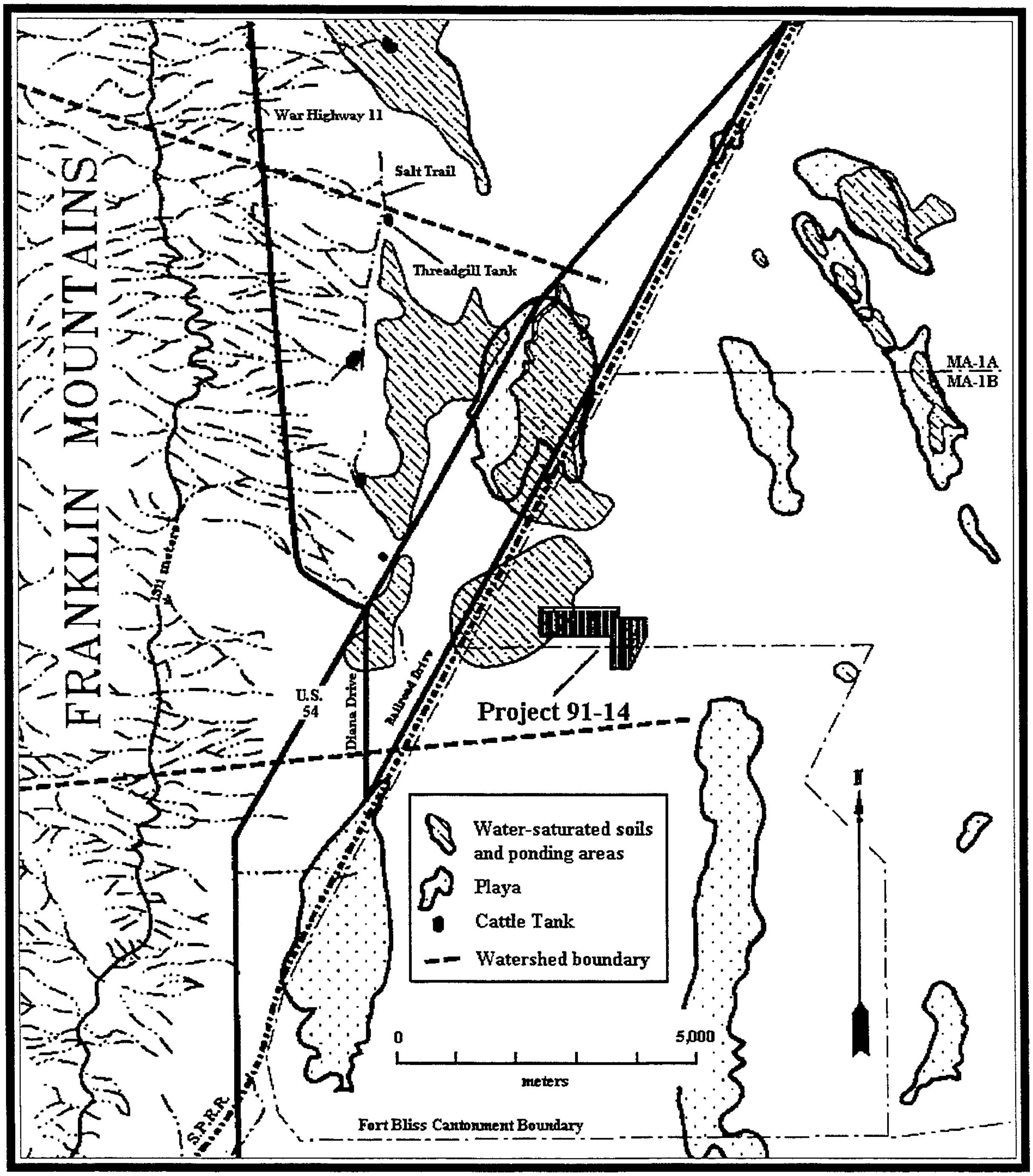

Figure 2.6. Watershed Obstruction due to Historic Construction (1944).

The 1890s saw additional construction that changed the runoff pattern and altered the landscape in the study area. Diversion of runoff began with the construction of the El Paso and Northeastern Railroad between 1896 and 1898. Today, the Southern Pacific Railroad (S.P.R.R.) still uses the original earthen embankments along the tracks. Since at least 1898, mesquite expansion has been less profound in the grasslands farthest away from the railroad, civilian ranching, and military-related soil disturbances. However, during this time in other parts of the grasslands, particularly those closest to the original Tobin Ranch, intensive cattle grazing effectively reduced grassland cover. Conditions that exist today are due in part to significant obstruction of the Fusselman Canyon-Anthony's Nose sheetwash entering the project area (Figure 2.6).

Between 1919 and 1926, until selling his land holdings to the federal government for the establishment of Castner Range, W. W. Threadgill used the water diverting efficiency of the Salt Road to replenish five water reservoirs on his property (Figure 2.6). These ponds were in the alluvial fan downslope from the section of the Franklin Mountains that, due to its orographic prominence, receives a majority of all rain that falls on the range.

Summary

This chapter documents the modern climate, physiography, geomorphology, soil types, flora, fauna, paleoenvironment, and historical influences on the Tobin Well area and the surrounding region. Several large playas near the project area have held water historically, sometimes for several months at a time. These playas are in a large geographic depression at the eastern base of the Franklin Mountains and are ideally suited for catching rainfall runoff. The effects of subsequent historic activities, which include encroachment of mesquite dunes and military maneuvering, on this natural water ponding area are helping to obscure and alter archaeological sites within the area, as well as change the flow of water. Since the beginning of the twentieth century, the western part of the project area has been affected more directly by civilian and military activities such as cattle grazing, military maneuvering, building, and road construction. In one area, mesquite has encroached approximately 225 meters northwest f the Tobin Well project boundary (Figure 2.5). Farther west toward the S.P.R.R. tracks, extensive mesquite growth is evident in a 1976 aerial photograph; however, a 1944 aerial photograph shows no mesquite. By contrast, little historic impact has affected the eastern margin of the study area where mesquite encroachment has been approximately 3 to 5 meters during the same period.

Today, military maneuvering has replaced cattle grazing in the grasslands, and mechanized vehicle traffic has created conditions less conducive for grasses to survive. Thus, weedy plants like mesquite are better supported and considerable mesquite encroachment has occurred.

Surface characteristics in and around the Tobin Well project area have undergone considerable modifications since prehistoric people populated the area. Part of this change is attributable to changing environ-

mental conditions over the millennia. As the fluctuating climate became progressively more arid and new technologies for supporting larger populations within it were in place, prehistoric settlement patterns shifted toward localized landscapes best suited to survival.

A multitude of modern cultural features have fragmented the original Fusselman Canyon-Anthony's Nose watershed that contributed the volume of rainwater in Stewart Lake and the surrounding grasslands. These features include historic cattle tanks, flood-control diversion canals, reservoirs, dirt and paved roads, railroad berms, parking lots, sidewalks, buildings, and other construction. Today, after being cut off from the additional rainwater recharge afforded by the nearby mountain watersheds, many playas rarely hold water for more than a few days unless historic construction has rechanneled this water through storm drains. This contrasts with conditions in the past where these locations received more unobstructed sheetwash and playas filled on a regular basis.

3

REGIONAL CULTURAL HISTORY, PREVIOUS RESEARCH, ETHNOGRAPHIC BACKGROUND, AND THEORETICAL EXPECTATIONS

by

Chris Lowry

This chapter outlines the current understanding of prehistoric occupations within the Hueco Bolson and surrounding areas of southeastern New Mexico and West Texas as interpreted by previous researchers. It also evaluates the validity of the current cultural-historical framework for the region and presents some of the problems with utilizing this type of framework for archaeological interpretation. Ethnographic data concerning hunter-gatherers and cultivators known from the Southwest and Great Basin portions of United States is then discussed. Next, empirical generalizations concerning hunter-gatherer mobility and subsistence is presented utilizing a model developed by Binford (1980). Settlement-subsistence options and assemblage expectations are generated from both archaeological and ethnographic data to guide attempts at interpreting the archaeological materials discovered at Tobin Well.

Cultural History

The cultural prehistory of this area is divided into several periods, beginning with the Paleoindian and continuing through the Historic period. For a more in-depth review and critique of past regional cultural developmental sequences, see Camilli, et al. (1988).

Paleoindian Period

The populations of the Paleoindian period, the earliest documented human presence in the El Paso region, were present in the region from as early as 11,500 to 8000 B.P. Isolated projectile points and open air sites are the primary representations of Paleoindian culture within the Tularosa Basin (Krone 1975; Beckes 1977; Whalen 1977, 1978, 1980; Carmichael 1986). Several sites are known within the region; however, few are reported in the literature.

Several isolated Clovis points represent the earliest reliable Paleoindian occupation for the region. Clovis occupations probably

were more extensive in the area, but no well documented sites are reported. MacNeish (1993) reports Paleoindian remains from Pendejo Cave dating back at least 50,000 years; however, the dates are not corroborated.

Several sites within the region have Folsom materials. Wimberly (1973) documents the Lone Butte site near Orogrande, New Mexico. Amick (1991) and Stiger (n.d.) studied Folsom material on Fort Bliss. Isolated projectile points, lithic fragments, and preforms, suggesting highly mobile and dispersed hunting activities, appear to dominate Folsom materials. Contemporaneous, supplemental foraging activities within the region are not well understood.

Small, mobile groups that ranged over extended territories hunting post-Pleistocene megafauna and gathering available edible plants characterize the overall pattern for the Paleoindian period. Population density was most likely quite low with small groups ranging over large areas in seasonal patterns following migrating animal herds. No structures have been found and Paleoindians are assumed to have utilized caves and rock shelters or portable hide shelters. Evidence for this adaptation, however, is scarce and not well documented. The nearest reported Paleoindian campsites to the project area are approximately 30 kilometers northwest along the flanks of the North Franklin Mountains (M. Stiger, personal communication). No Paleoindian components have been identified within the Tobin Well project area.

Archaic Period

The Archaic period in the El Paso region represents the longest span of occupation within the bolson. The time range for this period is approximately 8000 to 1750 B.P. Reports on surveys in the region (for example, Carmichael 1986), excavations at cave locales (for example, Cosgrove 1947), and open air site excavations (for example, O'Laughlin 1980; Fields and Girard 1983) characterize a broad spectrum of adaptation based on hunting and gathering with some evidence for sedentism during certain periods of the year. Using projectile point types and radiocarbon dates from several sites excavated in the region [for example, Todson Shelter, Pendejo Cave, and Fresnel Shelter (HSR 1973)], MacNeish (1993) presents a phase system for the Archaic period. The earliest is the Gardner Springs phase (6000–4000 B.C.) followed by the Keystone (4000–2500 B.C.), Fresnel (2500–900 B.C.), and Hueco (900 B.C.–A.D. 250) phases. These phase designations are tentative and should not be construed as actual periods of cultural time.

Further research into the Archaic by Anderson (1993), who bases settlement typology for the Archaic period on high mobility and seasonal use of the central basin, supports MacNiesh's phase system. Anderson bases her work on research conducted by Carmichael (1986) and classifies nearly 160 small sites into MacNeish's four phases. Her scheme defines three types of sites: (1) task force sites that lack hearth features and represent a limited set of activities, (2) microband sites that have less than four hearth features and represent family camps, and (3) macroband sites that have four or more hearth features and represent multiple family camps. With this typology, Anderson chronicles a series of changes based on the number of occupations at the different types of sites and the seasonality of these occupations. She suggests that mobility declined

through time, leading to an increase in macroband camps and task force sites in the Hueco phase. The extinction of Pleistocene fauna and a general increase in aridity caused these changes.

Structures documented for the late Archaic at the Keystone Dam sites (O'Laughlin 1980) resembled small brush huts located on the alluvial fans near the Franklin Mountains. Caves and rock shelters also were utilized by Archaic peoples. As populations increased through time, agriculture is thought to have become more important to the populations of the Hueco Bolson and Tularosa Basin. Increasing use of ground stone may reflect this increase in the utilization of cultigens, though the overall artifact inventory appears to have remained unchanged. Manos and metates are small and have small grinding surface areas reflecting the processing of wild plant seeds. Upham et al. (1986) document cultigens such as corn in the late Archaic. Radiocarbon dates of maize from Tornillo Shelter range between 1807 and 1195 B.C.

Overall, the data from Archaic sites within the bolson are still poorly understood, and little empirical archaeological evidence supports the theories proposed for Archaic adaptation and development. The Archaic has been characterized by increasing population density and multiple family groups that moved on a seasonal basis following available game and stopping where plant resources and water were available. In general, when climatic conditions changed, Archaic peoples may have had to rely more on plant foods with a greater range of environmental variability. This resulted in subsequent changes in settlement and subsistence, technology, and social organization.

Formative Period

Three general subperiods comprise the Formative period (A.D. 250–1400): the Mesilla phase (A.D. 250–1100), the Doña Ana phase (A.D. 1100–1200), and the El Paso phase (A.D. 1200–1450) (Lehmer 1948; Carmichael 1986; Bentley 1992a). Important changes that occurred during this period included the introduction of ceramic technology, an increasing use of cultigens, the introduction of more formal pithouses, and, eventually, pueblo architecture and the introduction of painted pottery. This period is also the best documented in terms of cultural explanations and forms the core of most archaeological interpretations for the region.

Mesilla Phase

The appearance of brownware ceramics and, probably, the bow and arrow (although the atlatl apparently continued to be used) characterize the Mesilla phase. Intrusive ceramics (Mimbres wares) appeared in the region after A.D. 750, but were not common. Painted pottery (El Paso Bichrome) also made its first appearance late in this phase. Pithouses occurred during this period (Lehmer 1948), but were generally similar to huts of the Archaic (Hard 1983b). Structures become increasingly formal after A.D. 600.

Mesilla phase sites generally are larger, more numerous, and contain more artifacts than sites from the earlier Archaic period. Whalen (1977, 1978, 1980, 1986) uses survey data for the region to propose a site typology based on site size, number of features, and the presence of ceramics, lithics, and ground stone. Though the characteristics change through time, Whalen suggests that artifact variety and site size distinguish residential sites from camps. Recorded Mesilla phase sites for all environmental

zones show a slight association between sites and playas in the central basin. Because all types of sites are found in all zones, Whalen believes the subsistence practices of the Mesilla phase relied primarily on hunting and foraging, supplemented by agriculture, and that occupation of the bolson was residential in nature.

Other archaeologists see the Mesilla phase as a continuation of late Archaic subsistence and settlement practices (O'Laughlin 1979; Carmichael 1986; Hard 1986). Carmichael's (1986) work in the area differs in some respects from Whalen's, especially in defining the role of the Hueco Bolson in cultural development. Carmichael believes that the basins of the region could not have been the entire area utilized by prehistoric groups. These basin areas were nonresidential in nature rather than being used by sedentary peoples. Residential sites (defined as sites containing trash middens) were probably outside of the basins, most likely near the Rio Grande. Carmichael does not see a linear-cultural progression for the Jornada peoples, but rather a cyclical progression of increased population followed by declines. Despite some differences, Carmichael's interpretation of cultural development for the region is similar to Whalen's: gradual population, technological, and social organizational increases through time.

Research by Hard (1983a) puts forth a settlement-subsistence model in which differences in environment influence choices for seasonal rounds and activities. Hard believes that winter and spring sites were on the mountain alluvial fans, while the central basin was used for foraging. The summer and fall seasons saw the central basin used for temporary residences. Continuing studies have not contradicted this model.

Research by Mauldin, et al. (1993b) indicates that Mesilla phase peoples may be characterized as residential foragers. The central basin and alluvial fans are thought to have been components in a residential foraging strategy in which groups lived throughout the region as hunter-gatherers. After A.D. 600, feature-related activities in the central basin drastically decreased. Mauldin believes that this may indicate a shift in the settlement and subsistence practices of these groups.

Research by these archaeologists, then, characterizes the Mesilla phase population as increasing in numbers from the Archaic, utilizing all environmental zones, and showing trends toward sedentism. The introduction of pottery may have been important for cooking and storage of wild plant resources and cultigens. Ground stone inventories indicate increasing use during this period. Settlement was probably seasonal with huts utilized as summer abodes and deeper pithouses used as winter residences. Subsistence was based on generalized hunting (rabbits and small game) and foraging for wild plants. Agriculture early in this period may have been more opportunistic, with increasing reliance coming later in the period to offset environmental variability that increased the risk of not having enough food to survive the winter (Wills 1988).

Doña Ana Phase

Lehmer (1948) characterizes Doña Ana phase sites by the presence of El Paso Bichrome and El Paso Polychrome pottery associated with adobe surface construction. Debate continues about the ability to distinguish Doña Ana phase occupations within

the archaeological record (see Carmichael 1986; Mauldin 1993a, 1993b). Scarborough (1986) excavated a Doña Ana phase pithouse village dating to the late twelfth century. Data from this site indicate the use of deep square-shaped formal pithouses and utilization of discrete trash middens, suggesting a more sedentary existence than earlier time periods. Cultigens such as corn, squash, and beans were recovered, as well as large amounts of rabbit bone. One other early pueblo site excavated in the region (Kegley 1982) contained evidence of formal pit structures with plastered hearths, as well as a very large pit structure believed to be a communal house. The latter may signify increasing social organization. Research by Whalen (1977, 1978, 1980) indicates that increasing population levels and a shift of settlement areas to runoff zones on lower alluvial fans of the Franklin, Hueco, and Organ Mountains characterize this period (which he defines as the Transitional Pueblo period).

Overall, the changes that occurred during the Doña Ana phase included (1) the introduction of polychrome pottery, (2) rapid population increase, and (3) artifact changes that included larger manos and metates, decreased projectile point sizes with larger forms still in use, and changes in intrusive ceramic types from Mimbres to Chupadero and Chihuahuan wares. In addition, increasingly formal pit structures eventually led to later pueblo architecture of the El Paso phase. Another crucial change that occurred during this time was the shift from a general use of all areas within the region to concentrated use of specific environmental zones. These areas included the river and the distal alluvial fans (transition zone) that are notable for their abundance of water and arable land for growing cultigens.

El Paso Phase

The final and most intensive prehistoric use of the region occurred during the El Paso phase or Pueblo period. An increase in the number of large and small residential sites, increased artifact densities, and a clustered settlement pattern characterize this phase (Whalen 1977, 1978; Carmichael 1986). The most obtrusive diagnostic artifacts for this period are the locally produced painted pottery wares, El Paso Bichrome and El Paso Polychrome, and the introduction of small triangular projectile point forms. Larger projectile point styles regularly found on room floors suggest the possible continuing use of the atlatl in conjunction with the bow and arrow.

Several excavated late Pueblo period sites provide data on subsistence and settlement. Data from Hot Wells Pueblo, a 100-plus room village near the eastern edge of the Hueco Bolson (Brook 1970; Bentley 1993); La Cabrana, a small pueblo near the Rio Grande (Bradley 1983); Firecracker Pueblo (directed by T. C. O'Laughlin), located on the alluvial fans of the Franklin Mountains; and other projects (Lehmer 1948; Gerald 1988) suggest varied settlement patterns and different structure types.

Hueco Bolson survey data outline important changes that occurred during the El Paso phase. Whalen (1977, 1978, 1980), who documents a cluster of large sites along the alluvial fans of the Franklin and Hueco Mountains, suggests that a shift in settlement patterns from earlier phases may indicate increased use of the lower alluvial fans for farming activities. Carmichael (1986) docu-

ments similar areas in the northern Hueco Bolson that he suggests were established during the Doña Ana phase. He argues that the sites are part of a larger regional exchange network related to Casas Grandes in Mexico.

Mauldin (1986) developed a settlement-subsistence model for the El Paso phase based on Hard's (1983a) work with the Mesilla phase, but assuming more dependence on agriculture. Mauldin suggests a division between primary villages and secondary villages. Primary village locations are near reliable water sources on mountain slopes but have fluctuating population during the year and a high intensity of use. Agriculture is the primary subsistence base at these sites. Secondary villages, which are located on both mountain slopes and in the central basin near playas, are associated with late summer residential occupations based on hunting and foraging. This and other settlement and subsistence models for this region do not include small sites (for example, campsites and limited activity sites). The debate over the role of agriculture and its importance to subsistence for this period is unresolved, as is the degree of sedentism.

Thus, peak population levels, diverse artifact assemblages, use of pit structures and above-ground pueblos, and dependence on agriculture—but not to the exclusion of hunting and foraging—characterize the El Paso phase. Researchers further postulate residential permanency at sites during wet years and seasonal movement during periods of dryness. Additionally, a seasonal sedentary lifestyle alternating between the desert floor, alluvial fan, and riverine habitation may have been the norm.

Protohistoric and Historic Periods

Some researchers suggest that after the mid-fifteenth century the prehistoric population of the region abandoned the desert floor area (Kelley 1952). Brethauer (1977) describes the sparse, scattered population of the Tularosa Basin and Hueco Bolson area as nonsedentary hunting and foraging groups of uncertain identity and origin. This perception of fifteenth-century abandonment may require modification.

El Paso phase villagers may be direct ancestors of the Protohistoric Manso, Suma, or Jumano people documented along the Rio Grande beginning in 1582 (Bentley 1992a; Hickerson 1994) and may have occupied the desert floor and alluvial fans during part of the year and the river area during the remainder. The times during which the early Spanish explorations did not record sightings of Manso or Suma along the river may have been those seasons when hunting and foraging were conducted along the low gradient alluvial fans of the desert floor. There is no record that the Spaniards ventured onto the desert floor until the mid-seventeenth century.

Multiple factors are believed to have caused the massive decline of these Manso and Suma cultural groups. The first was their acculturation into Spanish society. Second, subjected to European maladies like diphtheria, malaria, measles, smallpox, typhus, and whooping cough, their overall population declined due to a lack of biological tolerance for foreign disease. Widespread smallpox epidemics, for example, occurred between 1693 and 1709, and again in 1780 (Bandelier 1890; Lange and Lange 1970; Bentley 1992a). In all cases, large numbers of Manso and Suma died.

Near the end of the nineteenth century both groups were nearing cultural extinction.

At present there is neither comprehensive data nor a clear understanding of the Protohistoric period. Therefore, it is unknown how or when the desert floor was used immediately prior to historic contact.

Apache groups inhabited the region from the time of Spanish contact and utilized several canyons in the Organ Mountains (Freeman 1977, 1981). Historic occupation of the region appears minimal before the cattle ranching and mining of the 1880s. A Fort Bliss project directed by Ken Faunce (1997) provides an excellent, detailed summary of the Historic period in and around Fort Bliss.

Discussion

The cultural history of the region appears to indicate a gradual increase in population and a decrease in mobility through time. The numbers and sizes of sites appear to have increased with a concomitant shift in subsistence from hunting and foraging to one focused more on intensive agriculture. Sedentism probably increased but it is unclear whether later occupations were fully sedentary or merely seasonal.

Is this cultural-historical framework useful in explaining cultural diversity and adaptational processes within the region or is it simply a normative method to explain what we as archaeologists see in the record? Camilli et al. (1988) in their evaluation of the regional cultural-historical explanations outline six major problems with past researchers' interpretations. The first deals with the fact that field methods used to collect archaeological data are usually not comparable within and between projects (Camilli, et al. 1988: 18). Problems such as inconsistent site and isolated observation definitions and different survey methods hinder interpretations of the archaeological record and subsequent explanations about past cultural systems.

The next two problems concerning cultural evolutionary frameworks deal with site size and sample size estimates. Sites defined in past projects are large; Camilli et al. (1988: 20) describe them as "huge." Ethnographic studies of hunter-gatherers indicate that site sizes varied from 20 to 500 square meters (Yellen 1977). Whalen's overall average site size is nearly 6,000 square meters. What this probably indicates is multiple reoccupations through time making site area estimates by phase unworkable.

Sample size estimates by phase are also a hallmark of cultural evolutionary studies. Survey projects from the region (Whalen 1977, 1978; Carmichael 1986; Mauldin 1993) estimate occupational intensity from the number of chronologically dated sites in their samples. Of the 7,896 sites recorded from these projects, 6,854—nearly 92%—could not be assigned to any temporal category (Camilli et al. 1988: 21–22). It appears that the sample of sites used for occupational intensity estimates is quite small and probably highly suspect.

The last three problems noted by Camilli et al. (1988) are theoretical in nature and concerned with temporal-functional aspects, site function definition, and residential definitions. Chronological placement of most sites uses the presence of El Paso brownware ceramics as a guideline (Camilli et al. 1988: 23). Plain wares are early and polychrome wares are late. The problem lies with the fact that polychrome wares are only

painted over part of the vessel. Thus, if a site contains 20 brownware sherds and no polychrome sherds it is automatically an early (Mesilla phase) site even though there is a possibility that the vessel may have been polychrome. El Paso Bichrome, a single-paint vessel, fills the early-late gap in the ceramic sequence even though it is extremely rare and may even be eroded polychrome. Such problems make assigning temporal categories to sites difficult.

Site function and residence definitions also rely on tenuous traits to make them work. Carmichael (1986) defines a residential site as one containing a trash midden. Would a location used for a short time to process clams (and leaving a midden) be a residence? Under Carmichael's definition it would, yet if it was actually known what took place at that location the conclusion would be altogether different.

What this all leads to is the fact that none of the above criteria can be questioned or evaluated in a scientific sense. How does one check if one site definition is better than another or know if brownware sites are earlier? The answer is one cannot because these definitions and criteria are arbitrary and probably do not reflect cultural reality.

Burgett and Leach (1994) see the normative cultural-historical framework as more of a hindrance to interpreting much of the variability within the archaeological record. For example, within the region larger sites with more artifacts are seen as "better" than smaller, less diverse sites. One solution is to drop the use of such frameworks entirely and concentrate on more theoretically derived avenues of research.

The cultural-historical approach may be useful as a heuristic device whereby archaeologists may put together all their data about a culture period and attempt to generalize how prehistoric peoples of the region lived. As a method for understanding cultural and ecological change, however, the cultural-historical method hardly seems adequate. At best, the method can outline when major changes occurred, but cannot say what may have contributed to them, or how, or more importantly, why they happened. Archaeologists are still searching for an answer to this perplexing dilemma. Though no ready-made answers are forthcoming, archaeologists are shifting methodological gears and asking questions of how prehistoric southwestern groups adapted to the various ecological and cultural changes going on around them. An approach geared towards theory first and method second may hold some of the answers.

Archaeologists within the region must also try to interpret the archaeological record from the standpoint of how it was formed and the factors and processes that influenced it, rather than take for granted that what lies on or in the ground is somehow a time capsule waiting to be discovered and interpreted. Burgett (1994a) and others (Blair et al. 1990; Doleman and Swift 1991) call on archaeologists working in sand dune environments to pay close attention to the geomorphology of a region and the possible effects this type of environment may have on interpretations of artifact and feature distributions and spatial patterns. Once it is realized that dynamic processes (especially in the Jornada Mogollon region) affect the archaeological record, methods and strategies can be developed to counter outside influences and provide a more factual account of the past, rather than one based upon conjecture and speculation.

Ethnographic Background

The purpose of this section is to provide a general background discussion about some of the cultural groups known to inhabit sections of the greater Southwest. The idea is not to provide the basis for ethnographic analogy, but rather to outline some of the adaptive patterns of ethnographically known groups. Settlement-subsistence options and assemblage expectations generated by past researchers helped to guide analysis of the Tobin Well material and hopefully allow for some interpretation of the archaeological record for this region. Each section discusses general patterns under the research domains of settlement and mobility, subsistence, and technology. Camilli et al. (1988) and Ebert (1992) utilize a similar framework for discussing ethnographic data, primarily because it is within these domains that archaeologists have researched and studied extensively in the past. Their lead will be followed in this regard. The primary research goal, then, of this report is to identify functional locations or site types on the landscape. Given the nature of the study area and methods used, such a goal may not be immediately obtainable; however, such research is a baseline for further studies. Other sideline studies that contribute to the greater knowledge database concerning the Jornada Mogollon can be found throughout the report.

The first section focuses on hunter-gatherers, primarily because this adaptation was the longest lived within the region. Several groups serve as examples for this part. Cultivators are addressed next because this adaptation is believed to be more recent and short lived. The Pueblo Indians as well as other agricultural groups serve as examples for this section. Finally, this section examines the local indigenous populations of the El Paso area to give an impression of adaptation in the harsh desert environment.

Hunter-Gatherers

Settlement and Mobility

Several ethnographic sources outline general information concerning settlement for southwestern historic groups. Steward (1933: 238–239) reports that the Owens Valley Paiute moved seasonally and had village locations in the mountains and valleys. Villages were generally small, comprising one to five families. Manners (1974: 86–88) reports winter camps were most likely inhabited by larger groups while summer camps consisted of one or possibly two families. Summer and fall villages were in the valleys near springs or streams while winter and spring villages were in the mountains near pine nut stores. Winter villages were near springs only if snowfall that year was not heavy. If pine nuts were bad that year then valley villages were occupied.

Kelly (1976: 6) found that the Southern Paiute also moved seasonally between mountain and valley locations. Summer locations were near springs in the canyons while winter locations were caves in the canyons or on top of the surrounding plateaus. The Surprise Valley Paiute reported by Kelly (1932) moved over extensive territory in pursuit of subsistence needs. The Surprise Valley Paiute wintered at the lower mouths of mountain canyons or on valley slopes and generally moved from one camp to another throughout the winter months. Winter camps generally had five to

six houses while the summer camps had only two to three (Kelly 1932: 77–78).

The Utes moved over large expanses of territory to provide enough food for their groups. Little information was available about their movements, but the use of summer and winter structures infers seasonal moves. Janetski (1991: 40) reports the Ute winter camps as being in valley bottoms near streams or lakes where water and fuel was plentiful. Summer was spent in the foothills and mountains where game and some gathered resources were plentiful. Janetski (1991: 36) estimates village size between 5 and 10 households, which translates to approximately 25 to 50 persons.

The Gosiutes traveled extensively in their quest for food (Malouf 1974). Most of their territory was harsh desert interspersed with mountains and broad valleys, and they moved between the valleys acquiring food, water, and materials for survival. The desert between the valleys was marked only by a string of camps—no hunting and gathering was done in the desert. Winter camps were usually in the mountain foothills while summer camps were in the valleys (Malouf 1974). Winter camps were occupied from the late fall to early spring when food stores ran low and fresh greens could be found lower in the valleys.

The Southeastern Yavapai wintered in the mountains in caves, rock shelters, or brush huts and spent the summer months on the mountain edges and foothills, making forays into the valleys for game or gathered foods (Gifford 1932: 203).

Haley (1981) and Buskirk (1986) report that Western Apache groups moved frequently to areas where hunted and gathered resources were abundant. Buskirk (1986) states that Western Apache groups pursued a seasonal round during which summers were spent in the lush mountain foothills and winters were spent in the lower desert elevations. In either location, camps could be moved several times depending on the availability of needed resources. Group size ranged from one family to several extended family groups.

Opler (1974) reports the Lipan Apache of western Texas as generally mobile hunter-gatherers who stayed sedentary for limited periods of time while processing and storing hunted and gathered foodstuffs. Winter camps were the largest and most stable settlements. During other times of the year, group size varied from a single family to several families depending on the availability of desired resources.

Subsistence

Steward (1933: 239–246) reports the Owens Valley Paiute relied primarily on gathered seeds and roots collected in the summer and fall months and stored surplus food in lined pits in special cache locations. Pine nuts (pinyon) were an important staple harvested in the winter, generally at the time the village moved to the mountains. Fishing was undertaken during the spring and summer, while hunting occurred throughout the year. Game animals included deer, antelope, mountain sheep, rabbits and other small game, and birds. Home territories ranged from 15 to 20 square miles in size (Steward 1933: 252–256). Gathering of wild foods was the most important part of Gosiute subsistence. The Gosiute round was similar to that of the Owens Valley Paiute: early spring, the time of low food stores, was the time for gathering fresh greens near streams, lakes, and foothills. Summer was the time

for gathering edible roots, seeds, and berries. Fall was the time for gathering and storing pine nuts, and some groups traveled nearly 50 miles to gather enough pinyon for the winter (Malouf 1974: 26–27). Hunting throughout the year was also important and included deer, antelope, rabbits, mountain sheep, birds, some fish, rodents, lizards, and insects. Large game animals were taken by single hunters or by communal drives using corrals, pits, blinds, and other techniques.

Manners (1974: 69–75) reports that the Southern Paiute and Chemehuevi utilized agriculture to a limited extent, but relied primarily on hunted and gathered foods. They harvested new "green" plants in the early spring when stored food supplies were at their lowest. Early summer saw the collection of seeds in the valleys and low mountain slopes with distances of up to 40 miles being traversed. Edible roots and wild berries were collected in the late summer. Pine nuts were harvested in the early fall and winter and cached in rock shelters or special pits along with other storable foods (Manners 1974: 75–78). Hunting occurred throughout the year with deer and rabbits being the most common animals taken. Gathering more than hunting determined group movement and the distances traveled.

Kelly (1976: 41–47) reports that the Southern Paiute relied mainly on gathered seeds that were available in the late summer and early fall. Yucca and pinyon were also important in the fall as they were suitable for storage during the winter and early spring when gathered foods were scarce. Mescal, juniper berries, and cacti were utilized when other plant foods failed to produce. Surplus nuts and other storable foods were cached in pits in caves or rock shelters. The Southern Paiute practiced agriculture to a limited extent prior to the arrival of the Europeans, with some groups planting corn, squash, and sunflowers. Fields were near springs to facilitate irrigation. Planting occurred in June—groups left when corn came up and returned when the shoots reached 8 inches to stay until harvest (Kelly 1976: 39–40). Hunting occurred year round and took place in the valleys and mountain plateaus. Small parties of one to three men hunted larger game animals (deer and antelope) and used blinds or partial corrals to aid in killing. Large game animals were generally butchered on the spot with some meat cached for later return; some meat was dried for storage. Larger groups utilizing surrounds or nets hunted smaller game animals such as rabbits, squirrels, rats (Kelly 1976: 47–54).

Kelly (1932: 75) describes food gathering activities of the Surprise Valley Paiute as, "extensive and continuous rather than concentrated and seasonal." They fished the mountain steams in early spring until the snows allowed them to cross the valley to the foothills and gather roots or recover foods stored the year before. In the late summer, the Surprise Valley people moved into the valleys to harvest berries and seeds. With the onset of fall, some gathering continued, but the focus of group activity turned to hunting (Kelly 1932: 76). Hunted animals, including deer, antelope, and rabbits, were generally taken year round. Fall activities focused on communal rabbit drives and hunting of fowl. In winter, the groups returned to the winter camps to live on gathered seeds, meat, and other cached foods (Kelly 1932: 76–77).

For the Surprise Valley people, hunting was generally a group activity. Deer and antelope were subject to drives as well as

single-man hunts. Brush corrals were also used when hunting antelope. Other game included bear, wildcat, groundhogs, and small game such as squirrels, rabbits, small rodents, insects, and birds. Butchering was usually done at the kill site and the meat was prepared by either stone boiling, roasting in a pit oven, or baking directly on hot coals (Kelly 1932: 81–97). Fishing in the spring months was also an important source of food. Gathering took place year round and focused on seeds, berries, roots, and sometimes pinyon nuts. Roots were harvested with a digging stick and either consumed or processed for storage. Seeds were treated in a similar manner (Kelly 1932: 97–99).

The Utes hunted deer, rabbits, elk, antelope, and fish and gathered seeds, berries, and pinyon. Deer, the preferred meat, was usually pounded on a flat stone with a mano and then dried. Birds, small animals, and insects were also consumed by the Utes. Groups or individuals hunted deer and they sometimes made long trips for hunting buffalo. Fishing for some Ute groups was also important and could provide a storable resource (Smith 1974: 46–64). Gathered foods included roots harvested with a digging stick and roasted in a rock lined earth oven and berries, seeds, greens, and pine nuts. Caching of foods was extensive. Bark-lined pits under cliff overhangs and tree platforms were common methods of storage (Smith 1974: 64–68). Janetski (1991: 40) reports that the Ute spent the winter near streams and lakes in valley bottoms. Here, they consumed stored foods and hunted deer and rabbits. Early spring was the time to fish the lakes and streams while late spring was the time for winter camps to disperse to the lower valleys and marshes to harvest greens and shoots. Summer was spent hunting waterfowl in the valleys and larger game in the uplands. The hotter months were spent in the mountains where game and gathered resources such as berries were more plentiful. Late summer and early fall was more complex as game hunting, seed gathering, pinyon harvesting, and fishing all became important to preparing food for the coming winter.

The Southeastern Yavapai hunted deer, mountain sheep, and other large carnivores, as well as rabbits and other small rodents. Gathered foods included mescal, saguaro, prickly pear, acorns, pinyon, and mesquite. Food was generally prepared by boiling in earthenware pots, stone boiling in baskets, parching, baking in earth ovens, frying on hot stones, and broiling in fires (Gifford 1932: 205). Mescal was available in any season, while acorns were gathered in August. Prickly pear and sunflower seeds were gathered in September. Foods such as mesquite, seeds, and berries were gathered from May to July (Gifford 1932: 206–212).

Haley (1981) and Buskirk (1986) report that Western Apache groups relied primarily on hunting and gathering, supplemented by horticulture. The annual round consisted of year-round hunting accompanied by seasonal movements to areas of gathered resource abundance. Early spring was the time to harvest narrow leaf yucca stalks for roasting. In the late spring the flowers of this plant were gathered to make soup. Late spring and early summer was the time to gather and roast agave or mescal, the primary gathered plant of the Apache. Groups of women left the camp, sometimes for days, to gather and process mescal for immediate consumption or storage in caches for later use (Haley 1981: 91) Early summer was also the time for planting gardens in the mountain camps.

When the plants reached 3 feet tall, the group moved to the lower elevations to gather other wild foods (Buskirk 1986). Berries were at their peak during midsummer. Early fall saw the return of the group to the mountain camps to harvest the gardens planted earlier. Harvested crops of corn and squash were prepared for eating or dried and stored in cliffside caches until needed (Buskirk 1986). Pinyon, walnuts, and acorns were also gathered prior to moving to the winter camps. On completing this task the group moved to the lower elevations to camp for the winter and gather tornillo, desert yucca, datil, and mesquite.

Haley (1981: 84–88) and Buskirk (1986: 127–135) report hunting occurred throughout the year with peak times around the late spring and early fall. Deer, antelope, rabbits, birds, and other small game were taken when available, deer being the most important. Small groups of men departed the camp for the hunting grounds and, once there, split into single individuals to pursue game. Surrounds, blinds, and corrals were used to capture and kill game (Buskirk 1986: 127–128). All Western Apache groups used arrow poison to a limited extent.

Opler (1974) reports that the Lipan Apache groups subsisted mainly on hunted and gathered foods. Hunting was the most important aspect of subsistence and planned movements were crucial. Men generally hunted in small groups of one to three people. Camps were small and ready to move at a moment's notice. In the mountains, deer, elk, and mountain sheep were taken, while in the plains, buffalo, antelope, and rabbits were hunted. Fish and birds were also taken on occasion. Large numbers of men participated in buffalo or other large game hunts that they generally planned in advance, keeping in mind the weather and seasons (Opler 1974: 203). Rabbit surrounds also involved larger groups of men, women, and children. The women gathered mescal, nuts, berries, mesquite, and seeds. Agave was the primary gathered item, generally collected as a group activity similar to the Western Apache groups (Opler 1974). The Lipan practiced limited gardening during sedentary periods when the environment allowed.

Technology

Steward (1933) describes the technology of the Owens Valley Paiute groups who used stone for manos, metates, mortars, pestles, projectile points, knives, and arrow shaft straighteners. Obsidian and chert were the preferred materials for projectile points and knives. Spears, bows, bowls, arrows, and housing materials were wood. Pottery was utilized to an extent, mostly for cooking and storage. Basketry was utilized extensively for carrying seeds and water, cooking by stone boiling, and storage. Housing varied from solidly constructed winter mountain houses of poles and thatching to simple dome-shaped thatch huts used in the summer. Winter valley homes were identical to mountain homes with the addition of an earth covering built over a shallow pit (Steward 1933: 263–266).

The Gosiute used round winter shelters of poles, bark, and brush. Summer shelters were usually no more than wind breaks constructed of sagebrush used while traveling from one area to another (Malouf 1974: 31–33). Other items of material culture included manos and metates, which the group transported. Knives of chalcedony and other suitable material such as obsidian and chert were also used. Knives were generally hafted, but some used only a skin protector. Bows and

arrows were the weapons of choice with arrow points being side-notched and made of flint, jasper, obsidian, and quartzite. The manufacture of stone tools involved using hard hammer percussion for reducing the core to produce usable flakes. Flaking tools of sharpened bone or antler were then used to fashion the usable flake into a finished product (Malouf 1974: 37). Cobbles were used as hammerstones and mauls; axes were not used. Basketry was used for nearly all carrying and cooking containers, though pottery was used before the arrival of European settlers.

Kelly (1976) documents the use of stone for manos and metates for seed grinding and wood for spears, bows, clubs, arrows, and digging sticks among the Southern Paiute. Basketry was utilized extensively for storage containers and pottery was used to a lesser extent for cooking.

The Surprise Valley Paiute utilized conical mat or grass-covered lodges in the winter that usually accommodated up to nine people. Summer structures were generally either a sun shade or a simple brush enclosure (Kelly 1932: 104–106). Kelly (1932) reports the use of 6-inch obsidian knives by the Surprise Valley Paiute for butchering game. They also fashioned tools such as axes, arrow points, and knives from obsidian. Obsidian was sometimes carried from the quarry area to the camp to be further reduced into tools. Some knives were hafted with wood or bone. Scrapers, as well as scavenged tools from old sites, were also used. Manos and metates were used; manos were generally kept, while large metates were left at the camp. Some small metates were carried with the group (Kelly 1932: 137–141).

The Utes utilized brush shelters in the summer and more carefully constructed lodges of poles, smaller wood poles, strips of wood, and bark or matting for winter habitation. A shade of leaning poles and brush was also used in the summer. The winter house could sleep 10 to 12 people. Shelters were generally more sturdy if a long stay was planned. No set plan for a camp was established; shelters were scattered throughout the trees (Smith 1974: 33–46). The Utes used pottery for food storage and cooking. Jugs, cups, and large pots for cooking were all manufactured. Containers manufactured from basketry served as seed beaters, winnowing trays, berry baskets, and water jugs lined with pitch. Wood, horn, and hide were also used for containers (Smith 1974: 83–97). Manos and metates used for processing seeds were usually scavenged from old camps or archaeological sites. The bow and arrow was the primary weapon for hunting and defense. Arrow points were made or scavenged. Flint knives 6 to 10 inches in length were generally sharpened on one edge and hafted. Stone axes were manufactured by chipping a groove around a sharp piece of rock (Smith 1974: 97–114).

The Southeastern Yavapai utilized manos and metates, as well as bedrock mortars and knives manufactured from flint, quartz, and, occasionally, obsidian. Knives were fashioned from flakes knocked from cores and then retouched with antler flakers. Arrow points were made in a similar way. The mescal knife was shaped like a curved axe blade but had no handle and was used in a sawing manner. Axes for chopping and cutting were also used (Gifford 1932: 225–226). Pottery, basketry, gourds, skins, and wood were used for food storage containers and for carrying water or loads. The bow

and arrow was also used, as were digging sticks and tongs (Gifford 1932: 218–221).

Haley (1981) and Buskirk (1986) report that Western Apache technology was simple and portable. Structures were usually wiki-ups constructed of flexible poles and brush or simple brush arbors and ramadas. Basketry was common for carrying loads, storing food in caches, and carrying water (pitched jugs). Pottery was manufactured for cooking pots and storage. Weapons such as bows, arrows, and spears were fashioned from wood, as were utilitarian tools like digging sticks, hoes, and other such items. Haley (1981: 110) states that the Western Apache did not use arrow points, but sharpened and hardened their arrows. Projectile points were sometimes scavenged from camps of previous ancient inhabitants of the region. In contrast, Buskirk (1986: 121–122) states that arrow points were fashioned from a variety of stone (chert and obsidian preferred) and later from iron. In fact, the different Western Apache groups (Tonto, White Mountain, Chiricahua) utilized different point types. The Western Apache also reportedly used chert knives and agave digging tools.

Cultivators

Several groups of cultivators studied by ethnographers provide a rich source of information concerning how past native groups utilized agriculture to survive in the harsh desert environment. The Pueblo people of Santa Clara in northern New Mexico (Hill and Lange 1982), Havasupai of Northern Arizona (Spier 1928), the Pima and Papago of southern Arizona (Castetter and Bell 1942; Hackenburg 1964), the Cocopa, and the Hopi of northeastern Arizona serve as examples.

Settlement and Mobility

Spier (1928: 99–100) reports that the Havasupai annual cycle involved movement from the mountain plateaus to the lower parts of the canyons. Early spring was the time of return from the winter camps on the plateaus to the canyons. Rock shelters and caves were sometimes utilized while summer villages were being repaired. Spring was the time for planting crops in the well-watered canyons, while summer saw all people living in canyon villages. Late summer and early fall were the times of harvest and for gathering wild seeds and mesquite. In the late fall, people moved from the canyons to the plateaus to their winter camps.

Hackenburg (1964: 69–71) reports the Sand Papago lived in winter mountain camps for part of the year and summer valley camps for the remainder of the year; movement was constant in either case. The Desert Papago (Castetter and Bell 1942: 41–43; Hackenburg 1964: 72–75) also pursued a seasonal settlement pattern, spending the summer and fall near the fields or the edges of the valleys where rainfall runoff was most abundant. The field locations were generally 20 to 30 miles away from the winter camps (Castetter and Bell 1942: 41). Winter and spring were spent in the hills near springs or water wells. Cactus camps were occupied during part of the season when cactus fruits were ready for collection. The Pima constructed winter houses on high ground away from the fields and built summer shelters next to the fields due to the upkeep needed for canal irrigation techniques (Castetter and Bell 1942: 37–39). Hackenburg (1974) reports the Pima and Maricopa located their fields close to their villages along the banks of the Gila River in a continuous pattern rather than separating the two. Irrigation

canals were generally near the village and indicated a willingness to stay at that location more or less permanently depending on the water supply. Villages ranged in size from 20 to 50 dwellings surrounded by fields and canals (Hackenburg 1974: 121). Spier (1933: 18–22) reports the Maricopa settlements were scattered within a given area and always moving. Houses were generally 150 to 200 feet apart and extended downriver for up to 2 miles. Gifford (1933: 260) reports Cocopa settlements of 10 to 12 houses up to 500 feet apart.

Kelly (1977: 25–27) reports Cocopa groups living in only one permanent settlement throughout the year, but moving for hunting and gathering trips during different times of the year. Settlements were generally within the river delta area; however, flooding may have caused the village to move to the delta edge until the flood subsided (Forde 1931: 101). Camps for gathering agave, pinyon, and cactus fruits were in the mountain foothills and were sometimes occupied for up to three months during the summer. The camps were abandoned at harvest time. Wild rice gathering camps farther downstream were occupied until enough rice had been harvested.

Northern New Mexico pueblo groups lived what would be considered a sedentary existence compared to the Havasupai and the Papago. Prehistoric archaeological evidence indicates that these early cultivators were hunter-gatherers prior to the development of agriculture. Ethnographic data from Hill and Lange (1982) indicate that in early historic and prehistoric times, hunting and gathering played a much larger role in subsistence. Ellis (1974) also reports that the Hopi in late prehistoric and historic times were fully sedentary, living in mesa-top pueblo villages. These villages utilized springs or constructed reservoirs for water sources. Some villages were in the valleys near streams or springs. One or more clans usually constructed the village and located their fields at the mesa bottoms or some distance away. The occupation of dugouts or field houses near the fields was also a common practice (Ellis 1974: 125).

Subsistence

Havasupai subsistence (Spier 1928: 101) relied primarily on cultivation of corn, beans, and squash in the canyon bottoms. Irrigation techniques were used to water the crops although flooding from heavy summer rains was always a danger. Gathered foods were also important to a lesser extent and were relied on when stored crop food was running low, usually in the late winter and early spring. Mescal, prickly pear fruits, mesquite pods, yucca fruit, pinyon nuts, and seeds were utilized wild foods. Hunting occurred throughout the year but was most important in the fall and winter. Deer, mountain sheep, antelope, and smaller game such as rabbits were exploited. Stone and brush blinds and rabbit surrounds were used.

The Sand Papago (Hackenburg 1964: 69–71) subsisted primarily on hunted and gathered foods with limited cultivated crops supplementing their diet. Crops of corn and beans were grown on the valley edges to utilize rainfall runoff; irrigation techniques such as check dams channeled water into the fields. Gathered foods included mesquite, roots, seeds, and saguaro. Hunting lizards, rabbits, deer, mountain sheep, and antelope took place year round.

The Desert Papago (Castetter and Bell 1942; Hackenburg 1964: 72–75) utilized agriculture to a greater extent than their

neighbors; however, it did not outweigh the importance of more dependable food sources from hunting and gathering (Castetter and Bell 1942: 45). Fields of corn, beans, cotton, and squash were near their summer villages on the edges of the valleys, especially near the mouths of arroyos, to take advantage of rainfall runoff. The Papago used irrigation if the fields were near a running stream. The Pima used irrigation techniques extensively as their fields were near the banks of the Gila River. Summer villages also had reservoirs excavated by the village inhabitants; when dry, the village moved to the next reservoir location. Roots, seeds, berries, cactus fruits, mesquite, and mescal were gathered. Hunting deer, antelope, rabbits and birds was common throughout the year with the only notable difference between the Pima and Papago being the use of fish by the Pima (Castetter and Bell 1942: 71). Gathering trips were made from the base camps in both the summer and winter. The Pima and Papago also established permanent camps near saguaro cactus areas to harvest the seeds and fruits of these plants (Castetter and Bell 1942: 59). Castetter and Bell (1942: 56–57) estimate that prior to the arrival of the European settlers, Pima cultivation averaged 50 to 60% of the yearly food supply during an average year; hunted and gathered foods made up the balance. The Papago, in contrast, utilized approximately 20% of cultivated crops for subsistence needs, the balance being hunted and gathered foods. Thus, water availability played a crucial part of the decision to grow more crops. Hackenburg (1974) notes the Pima and Maricopa gathered most of their foods from the valleys and mountain slopes; little gathering was done in the mountains. Further, it was common for hunting and gathering trips to have more than one purpose. Thus, while the men hunted deer in the mountains, the women gathered food from the foothills nearby.

Gifford (1933) reports the Cocopa planted fields of corn, beans, and squash by July; harvest occurred in late September or October. Gathered foods included mesquite, grass seeds, wild rice, agave (mescal), and roots. Hunted animals included deer, rabbits, birds, and fish. Forde (1931) and Kelly (1977) report the Cocopa subsisted on cultivated corn, beans, pumpkins, and watermelons, as well as a wide variety of gathered and hunted foods. Cultivation began in April with the clearing of field locations, usually not formal, anyplace where good soil could be found. This meant that one family's crops were not necessarily next to each other or even close to the home. Planting occurred in July after the floods subsided and left a rich new layer of soil. During this time, wild rice was harvested. Prior to actual planting, irrigation devices such as check dams, levees, and ditches were constructed or cleaned out. Prior to and just after planting, Cocopa groups began gathering bird eggs, mesquite, and quelite seeds (amaranth or pigweed). Rabbit hunting also took place during this time. Weeding the fields took place in late August as did the gathering of screwbeans. Some groups moved to the mountain foothills to gather agave, dates, and pinyon and hunt deer and mountain sheep. Harvest occurred in October as did gathering grass and weed seeds for storage for the coming winter. Later summer through early winter was also the best hunting time for rabbits, birds, and other small game. Fishing was important from January through September and was at its best prior to and just after the yearly floods. Hunting occurred throughout the year, but was worst from March through July (Kelly 1977: 23–

26). Storage of gathered and planted foods was practiced, ideally in sufficient quantities to last through the winter months. Both pottery vessels and baskets were used for food storage and were generally kept on specially constructed platforms to keep out animals (Kelly 1977: 41–42).

Agriculture was the primary subsistence mode for most pueblo groups (Hill and Lange 1982; Underhill 1991). Corn, beans, and squash were the primary crops prior to the arrival of the Spanish. Cultivation was achieved through the use of simple wooden implements, and irrigation techniques were used extensively. Though individual action was important in pueblo farming, communal activity ensured that fields were cleared and irrigation works maintained (Hill and Lange 1982: 24–25). Several varieties of corn were developed, some for ceremonial use, others for consumption. Dry farming, which depended on summer rains for a good harvest, was common, although some groups utilized irrigation. Planting generally began in May and harvest time was in the early fall. Crops included corn, beans, squash, pumpkins, cotton, tobacco, and gourds. The Spanish introduced chili, wheat, watermelon, and other crops. Cultivation was primarily a male activity, but women were involved extensively. Cultivation usually involved communal groups working together on each family's fields (Hill and Lange 1982; Underhill 1991). Ellis (1974) reports the Hopi were farmers similar to the northern Pueblo groups but grew crops in a much harsher environment. The Hopi grew corn, beans, and squash primarily utilizing several different irrigation methods such as *akchin,* dry farming, check dams, and diversion canals. Planting occurred in mid-April to May with harvest between July and September.

Hunting was an important addition to the diet. Though not as important as agriculture, it was at least secondary. Hunted animals included deer, elk, buffalo, antelope, and rabbit. Generally, hunting groups consisted of three to four related men. Group hunts for smaller animals such as rabbits and prairie dogs were common. Some hunts were ceremonial and usually involved a special animal such as a bear or birds (Hill and Lange 1982; Underhill 1991). Fishing was important to groups near perennial water sources (Hill and Lange 1982). For the Hopi, hunting was an important subsistence activity prior to the arrival of the Spanish. Deer, antelope, mountain lion, mountain sheep, rabbits, and other small game were hunted. Some animals were hunted for subsistence, while others were taken for ceremonial purposes (Ellis 1974).

Gathering of wild plants was important to most pueblo groups. The cultivated diet was supplemented by plants such as wild potatoes, broad leaf yucca, various wild berries, wild seeds, and wild nuts such as pinyon, acorns, and walnuts (Hill and Lange 1982; Underhill 1991). Gathered plants were also important for the Hopi; seeds, pinyon, acorns, yucca, roots, berries, and tobacco were all exploited. Though not as important for subsistence, gathered plants served many medicinal and ceremonial purposes (Ellis 1974).

Technology

Spier (1928) reports that the Havasupai utilized wood for hoes, axes, digging sticks, bows, and arrows. Stone was used for arrow points, knives, and digging tools; obsidian or flint was the preferred material. Arrow points were generally triangular in shape with deep side notches. Long thin flakes

held between the thumb and forefinger were sometimes used for cutting or scraping. Manos, metates, mortars, and pestles were of stone. Pottery and basketry were used for food storage and cooking. Housing was of two types: dome-shaped huts constructed of flexible poles and thatching, and rectangular structures of poles, thatched walls, and dirt roofs. Both types were used in summer or winter.

Hackenburg (1964) reports the use of wood implements such as digging sticks, clubs, hoes, axes, bows, and arrows by both the Sand and Desert Papago. Axe heads, arrow points, hoe blades, manos, and metates were of stone. Both groups used pottery, although the Sand Papago's pottery was not as well constructed as their Desert counterparts. Both used basketry for carrying loads, storage, and carrying water. Houses constructed of poles and thatching were generally dome-shaped dwellings used in both the valleys and hills.

Gifford (1933) reports the use of pottery and basketry for storage and carrying burdens among the Cocopa. Stone was utilized for manos, metates, adzes, knives, and arrow points. Cores were reduced at the location of the quarry and then carried home for final working and sharpening. Edges were produced by grinding, not flaking. Heat treatment of stone made working easier. Hafting of adzes and knives was common. Houses were rectangular pithouses and dome-shaped wood shelters (Gifford 1933: 270–273).

Kelly (1977) reports two types of housing—earth-covered lodges and wood summer huts—among the Cocopa. The lodge, constructed of wood beams and poles and covered with earth, was the primary habitation unit for winter. The floor was up to 2 feet below the surface and rectangular in shape. These structures were generally made for married couples or large families. Summer structures were six-pole frames woven with smaller wood poles and thatching. The floors of these homes were only slightly excavated and were round to oval in shape. Such homes were common for visitors and single people within the group. Summer homes were near the fields (Forde 1931: 122). Wild rice gathering shelters were small four-pole type homes made of driftwood. Some Cocopa groups also constructed oblong, curved-roof homes.

Large storage pits were utilized for melons and other foods needing cold storage (Kelly 1977: 47–48). Pottery was used for bowls, pans, cups, ollas, and cooking and storage pots. Basketry was used for carrying burdens and storing goods. Other subsistence implements included the bow and arrow, digging stick, fishing nets, weeding tools, and traps. Stone was used for manos and metates, as well as for arrow points, which were generally triangular with side notches (Kelly 1977: 48–53). Forde (1931) reports the use of stone knives for hunting and fighting. Properly shaped rock pieces were sought, trimmed to a point, and then hafted.

Pueblo group technology was similar to that of the hunter-gatherer groups. Structures were aboveground pueblos, usually multistoried, constructed of large cut logs, poles, adobe, and thatching. Ceremonial structures were subterranean kivas constructed of similar materials. Wood was utilized for spears, bows, arrows, bowls, farming implements, and construction material. Stone was used for grinding tools (manos and metates), arrow points, and knives; chert and obsidian were the preferred materials.

Pottery was used extensively for carrying loads, storage, and trade. Basketry was utilized for similar purposes (Hill and Lange 1982: 73–121; Underhill 1991). Ellis (1974) reports similar technology among the Hopi. Wood was used for digging sticks, hoes, and other implements, and stone was used for manos, metates, knives, and arrow points. The Hopi also used naturally occurring coal for winter fuel and for firing their pottery.

Local Native Groups

Early Spanish explorers described several groups of people when they reached the El Paso region. Unfortunately, their accounts are extremely sketchy with little detailed information about settlement, subsistence, and technology. The Mescalero Apache reported by Basehart (1974) provide the most detailed account of hunter-gatherer settlement and subsistence for the local region. The Mescaleros inhabited a range extending north to Pecos Pueblo, west to the Rio Grande, east to the plains of West Texas, and south into the frontier of Mexico. They exploited an environmental area extending from the pine mountains to the low desert basins. Early Spanish travelers mention other documented groups such as the Mansos and the Jumanos, but give no detailed information.

Settlement and Mobility

Hodge (1910) reports that the Jumanos of northern Chihuahua and southern New Mexico-West Texas lived in semipermanent villages during part of the year and moved throughout a large area hunting buffalo and gathering wild plant foods during the rest of the year. Bandelier (1890: 80) reports that the Jumanos encountered between the Rio Grande and Rio Concho lived in villages of "houses with upright walls and covered with mud roofs." Hickerson (1994) feels the Jumanos were a single linguistic group who ranged over a very large territory. The plains Jumanos were bison hunters who relied on mobility. In contrast, the river Jumanos were sedentary agriculturalists.

The Suma moved about in bands ranging in size from 50 to 200 persons. They moved frequently, living in small brush shelters that, in winter, were covered with animal skins (Gerald 1970b). The Mansos lived northwest of the Suma, near Doña Ana, New Mexico. They may have been associated closely with the southern pueblo groups such as the Piros, as their language had similarities to those groups. At the time of Spanish contact, the Mansos lived in simple brush structures or rancherias and moved about the land hunting and gathering animals and wild plant foods. Prior to the arrival of the Spanish, the Mansos may have lived in pueblo style structures and been more sedentary. (Bandelier 1890; Gerald 1970a; Beckett and Corbett 1992).

The Mescaleros lived in highly mobile groups (or bands) moving throughout the range. A band ranged from 30 to nearly 200 persons depending on the time of year and the activities of certain group members. Basehart (1974: 106) finds two general movement patterns: large-scale migrations almost always based on seasonal subsistence activities and small-scale moves based on hunting and gathering. More permanent camps were always near available water, usually flowing mountain springs or streams. Other camps took advantage of available playas, rock tanks, or small water holes (Basehart 1974: 55–56). Hunting parties usually left the main camp to set up a base camp near the hunting grounds; from there small groups and single individuals

ranged out to hunt. If antelope were to be taken in large numbers, the camp was usually quite large; otherwise camps were small containing up to six families (Basehart 1974: 15–17). Bison camps were almost always very large since cooperative effort was necessary to take the animals. Gathering camps were away from the base camp in some situations and occupied between one day and a week depending upon the resource being gathered. Mescal, for example, was processed at the main camp if the distance to the gathering area was not too far (Basehart 1974: 31).

Subsistence

Hodge (1910) reports the Jumanos as part time farmers of corn, beans, and squash, as well as hunters and gatherers. Bandelier (1890) confirms the practice of agriculture among the Jumanos. Buffalo was a known hunted animal along with deer, rabbits, and fish. The Jumanos also gathered salt and wild plant foods such as mescal, agave, and seeds. The Sumas inhabited the area south and east of El Paso and are characterized as hunter-gatherers. They often raided their more sedentary neighbors for food; in this respect they were similar to the Apache and may have been related linguistically (Gerald 1970b). They hunted deer, ate fish, and gathered mescal, mesquite, prickly pear, roots, and wild seeds. Gerald (1970b) notes no agricultural pursuits. The Manso fished; hunted bison, small rodents, and rabbits; gathered wild plants such as mesquite; and may have practiced limited cultivation (Gerald 1970a; Beckett and Corbett 1992). Bandelier (1890) reports several instances of the Mansos living near El Paso and that they lived as hunter-gatherers until the arrival of the Spanish.

Hunting and gathering were the primary base for Mescalero subsistence, with some groups utilizing limited horticulture (Basehart 1974: 10). Hunting depended mainly on the deer, antelope, and bison. Lone hunters generally hunted deer, and small groups used surround techniques to hunt antelope. Organization of both deer and antelope hunts was informal. Bison hunts, however, were more formal affairs and generally involved an entire camp (about 30 persons) moving from the mountains to the eastern plains during the fall buffalo migrations. Smaller game, such as rabbits, prairie dogs, and other small rodents, hunted in times of food stress generally was not a dietary staple (Basehart 1974: 11–29). Mescalero women were in charge of gathering wild plant foods, which usually contributed an equal if not greater share to the diet than hunting (Basehart 1974: 30). Mescal, datil, pinyon, and mesquite were the staple gathered food sources. Mescal could be collected at any time during the year, but spring and fall were the preferred times. Mescal was a favorite because of its storage characteristics after processing. Datil also possessed good storage character and was abundant over a large area. Pinyon was available infrequently and generally collected during October. Mesquite was also a variable food, but still important to the overall diet as it was available over a very large area (Basehart 1974: 30–38). Other economically important plants included prickly pear, yucca, sotol, oak, and juniper. Minor resource plants included screwbean, a variety of grasses, wild potatoes, onions, greens, and berries (Basehart 1974: 38–50).

Technology

Hodge (1910) reports very little about Jumano technology saying that both pueblo

style structures and brush huts were utilized. Suma technology was simple—the bow and arrow and stone tools dominated (Gerald 1970b). The Mansos were known to use the bow and arrow, flint knives for butchering, wood bludgeons, nets, and pottery (Gerald 1970a; Beckett and Corbin 1992).

Mescalero technology utilized a variety of bone tools from hunted animals, as well as wood for weapons, gathering implements, structures, and fuel. Projectile points and food processing equipment such as manos and metates were of stone. Manos were usually taken with the group while metates were left at the camp for later use. Scavenging of old tools and arrow points was a common practice (Basehart 1974). Basketry was utilized extensively for carrying burdens, transporting equipment, and storing water or other foodstuffs.

Discussion

Several patterns become apparent from a review of the ethnographic literature. First, hunter-gatherer systems utilized the landscape in an extensive manner; they covered large territories and exploited a wide range of environments. Second, because of this extensive landscape use, these systems generally exploited resources in a planned manner depending on seasonal variations. If one area that was good for gathering seeds did not produce a sufficient crop for the group's needs, then a fallback area was almost always available. Cultivator systems, in contrast, depended on seasonal agricultural pursuits that inhibited mobility, even though hunting and gathering were still a part of the subsistence repertoire. Rather than extensive use of extremely large territories, cultivators intensively used the same area year after year. The Cocopa illustrate this pattern nicely; though farm locations may have changed from year to year within the delta region, these groups always returned to this region to plant their crops. In contrast, groups such as the Paiute and Mescalero Apache utilized broad expanses of territory, sometimes not returning to a place for years. Rather than being dependent upon one area for subsistence needs, these groups exploited several areas throughout several regions. Both systems, however, moved to different areas depending on the season and were not truly sedentary. The actual settlements or site types that these systems produced also varied. Cultivator systems produced a larger variety of site types than hunter-gatherer systems. For example, the Cocopa produced residential bases near fields, wild rice gathering camps, mountain gathering camps, and various other logistical locations scattered throughout their territory. Pueblo groups, as well as the Pima and Papago, also occupied field houses near the fields during planting, weeding, and harvest times. Hunter-gatherers, on the other hand, usually produced residential bases and associated logistical locations, as well as a few special purpose locations such as mescal processing locations or saguaro gathering camps. Both systems appear to have structured their settlement movements around seasonal factors and the location of water and other needed resources.

Subsistence appears to have been similar in both hunter-gatherer and cultivator systems in that hunting and gathering were never absent from either system. The only difference is the degree to which one system depended on cultivated plants. This difference is important because it affected mobility. Agriculture required a certain amount of time and energy to produce needed crops. Though mobility in these systems was never

absent, agriculture certainly reduced it for part of the year. Hunter-gatherer systems, however, had no such limitations. When resources of an area were reduced or did not replenished themselves over a period of time, the group simply moved to another productive location.

It would also appear that the reduction in mobility for cultivator systems led to an increase in technological investment. Cultivator systems invested more time and energy in housing and storage facilities than hunter-gatherer systems. Again, the Pueblos, Pima and Papago, and Cocopa illustrate this point well. These groups built substantial rectangular or square houses of earth or adobe and produced large quantities of undecorated and decorated pottery. Storage facilities were substantial rock-lined pits, platforms, and storage rooms. Hunter-gatherers utilized more temporary shelters that were generally circular and constructed of brush or hides. Pottery produced by these groups was sometimes decorated, but more often plain and probably produced for specific utilitarian functions.

These general observations are supplemented below by more specific patterns relevant to the study of prehistoric systems. The patterns presented were first reported by Camilli et al. (1988: 58–64) and follow a format utilized by Camilli, et al. (1988) and Ebert (1992). For this report, the patterns outlined by Camilli et al. (1988) have been borrowed and summarized.

Theoretical Expectations

The theoretical expectations presented below are the result of ongoing studies by many archaeologists and ethnoarchaeologists and utilize, as a starting point, the hunter-gatherer continuum outlined by Binford (1980). In essence, this outline presents two extremes between which hunter-gatherers may operate: foragers (people move to needed resources daily from a base camp) and collectors (people move resources to their residential base camp via logistical trips). A more complete explanation of this model is presented in Binford (1980). These are extremes of the continuum; most known hunter-gatherer groups fall somewhere in between and most utilize aspects of both strategies as responses to seasonal variation in the availability of certain resources. Binford's model provides a starting point from which to generate some expectations regarding adaptive strategies and assemblage content of the archaeological record (Table 3.1).

Several options would have been available for hunter-gatherers living in the El Paso region, though relevant ethnographic material for building a theoretical framework is lacking. However, researchers in the Great Basin have built a conceptual framework made up of settlement options from which to work. These options are a framework for recognizing what archaeological sites might look like for the Great Basin (Ebert 1992: 151–152) and are the culmination of work by many researchers (for example, Camilli 1983). Ebert lists four possible options that hunter-gatherers may have pursued:

1. Serial foraging: groups move continuously to resource areas; residential camps likely reused each year;

Table 3.1. Hunter-Gatherer Adaptations and Landscape Expectations (Burgett 1994c).

Adaptive Behavior	
Fine grained	Coarse grained
Forager	Collector
Subsistence needs: daily trips	Subsistence needs: occasional trips
Seasonal variability: low	Seasonal variability: high
Growing season: long, little variability	Growing season: short, highly variable
Storage: little to no food stored, technology not cached	Storage: stored food needed, caching of technology prevalent
High residential mobility	Low residential mobility
Low logistical mobility	High logistical mobility
Artifact assemblages: redundant if occupied during same season	Artifact assemblages: residential sites have high diversity; special purpose locations numerous and redundant
Technology manufacture and care continuous	Technology manufactured occasionally; care is continuous
Tools discarded when used up	Tools discarded when failure imminent
Tool and gear replacement based on broad range of activities	Tool and gear replacement based on periodic and anticipated scheduling
Residential bases located near resources, few special purpose sites; site re-use low	Very complex positioning of sites on the landscape based on resource availability, site function and season; many special purpose sites; site re-use very high

foraging locations not reused but distributed throughout the foraging area.

2. Seasonal fusion and fission: large multifamily camps occupied during the winter; both foraging and logistical trips; single family groups forage throughout the territory during most of the year; annually occupied winter residences; continuously distributed foraging loci; reoccupied logistic locations associated with seasonal residential base; for part of the year, movement similar to serial foraging.

3. Large, permanent residential base and associated logistic locations: year-round occupation in permanent base camps or villages; year-round and continuously distributed foraging loci; low density remains; year-round logistic loci used for same purpose or small set of functions.

4. Temporary camps: mobile people move through an area; usually part of logistic movement; a place to stay while moving to desired area; few procurement activities in area.

From these four options, Ebert (1992: 151–152) describes seven types of sites or areas of use: short-term residential bases (serial foraging, seasonal fusion and fission), foraging locations (serial foraging; seasonal

Table 3.2. Assemblage Expectations for Site Types (after Burgett 1994c).

	Short-Term Residential Base	Semipermanent Residential Base	Permanent Residential Base	Foraging Location	Logistic Location from Semi-permanent Base	Logistic Location from Permanent Base	Traveling Camp
Assemblage resolution	High	Moderately variable	Low	Highly variable	High	High	High
Assemblage variability	Low intra-assemblage	Moderate inter-assemblage	Low inter-assemblage	High inter-assemblage	High inter-assemblage	Moderate inter-assemblage	Low inter-assemblage
Occupation	Multiple	Reoccupied	Reoccupied	Single	Multiple	Reoccupied	Single or multiple
Assemblage diversity	Low	Very high	Moderate Low	Site area	Moderate	Low	Low
Site area	Depends on overlap of multiple occupations	Depends on re-occupation space require-ments	Constant	Small, possi-bly contin-uous scat-ters	Site area increases as debris in-creases	Site area con-stant, debris increases	Site area in-creases ad debris in-creases
Raw materials	Mostly local, some non-local	Wide range of local and non-local	Recycled non-local	Range of local and nonlo-cal	Nonlocal	Nonlocal	Nonlocal
Manufacturing stages	All	All stages, with local; later stages with nonlocal	All stages for local and nonlocal	Early stages for expedi-ent tools; very late stage for nonlocal materials	Middle and late	Late	Early for local, late stages for nonlocal
Curated or ex-pedient tech-nology	Both	Worn or broken tools	Worn or broken tools	Both, possibly broken cu-rated	Both	Both	Expedient, recycling of curated
Tool kit com-plexity	Simple	Highly complex	Highly complex	Highly vari-able	Complex	Highly complex	Carried kit highly com-plex, but generally not discard-ed at loca-tion
Technological specialization	Portable, bifaces and carried cores; general purpose tools dominate	General and spe-cial purpose	Highly special-ized, blades and bifaces	General pur-pose, low specializa-tion	Specialized	None	None
Site furniture	Low to none	Moderate to high	High	None	Moderate	High	Possible
Caching	Little or none	General and spe-cial purpose tools	Raw materials and tools of differing manufac-turing stages	None	In vicinity	High at location	Possible; food or water

fusion and fission; large, permanent residential base and associated logistic locations), semipermanent or seasonal multifamily residential bases (seasonal fusion and fission), permanent residential bases (large, permanent residential base and associated logistic locations), logistic locations from semipermanent, seasonal bases (seasonal fusion and fission), logistic locations from permanent residential bases (large, permanent residential base and associated logistic locations), and travel camps (temporary camps). Ebert (1992: 154–156) further provides a list of expected assemblage contents for each of these seven site types. Assemblage expectations generated by Burgett (1994c: 37–40) are listed in Table 3.2. A thorough explanation of these expectations can be found in

Ebert (1992: 134–150). If functional locations can be distinguished archaeologically, then the temporal dimension can be explored more fully. Such studies can inform archaeologists about the nature of adaptive change and the effects such changes have had on settlement, subsistence and technology.

Summary

This chapter outlines the accepted cultural-historical sequence for the Jornada Mogollon region and discusses implications of using such a framework for archaeological interpretation. The cultural-historical framework may be useful as a tool for organizing archaeological data, but not as a means of interpreting or explaining the record itself. As Binford (1983) stresses, the archaeological record does not speak for itself. It is a static phenomenon that archaeologists view in a contemporary setting. The challenge is to revise methodologies in order to link contemporary observations of the archaeological record to past lifeways of extinct cultural systems. The ethnographic background data is presented to give the reader a better understanding of how some cultural groups in the greater Southwest lived and utilized the environment to adapt successfully. Many of the patterns could have been (and probably were) utilized by the prehistoric inhabitants of the area. Using the ethnographic data as a guide, patterns based upon three research domains of settlement and mobility, subsistence, and technology aid in understanding how the prehistoric inhabitants of the region may have lived. These options generate seven site types that may be expected to occur within the archaeological record. For each of these site types, assemblage expectations are generated regarding a number of different variables. These expectations will be examined using individual analyses throughout this report in hopes of understanding the dynamics of the static archaeological record for the region.

4
SURVEY METHODS AND RESULTS

by

Chris Lowry

This chapter outlines the survey methods used and results obtained from Project 91-14. Phase I survey data was analyzed in detail to determine if survey procedures accurately recorded the surface archaeological record. The findings indicate that the methods utilized during the Tobin Well survey are not adequate to the task of recording most of the surface archaeological material. Survey crew experience may also contribute to the accuracy of recording the surface archaeological record.

The project recorded 48 prehistoric archaeological sites within a 1.08-square-kilometer area and mapped 109,229 square meters of site area within the 1,166,400-square-meters project area (Figure 4.1, Appendix A). This works out to approximately 9.4 percent of the project area lying within site boundaries. The presence of ceramics on the surface of 29 of the 48 sites provided data for relative dates. The other 20 sites cannot be assigned temporal designations and remain undetermined.

Survey Procedures

Western Hueco Bolson Survey

Dr. Michael Whalen (1978) originally surveyed the Tobin Well Area as a part of the Western Hueco Bolson Survey on Fort Bliss. Whalen had a crew of three with a survey interval of 45 to 60 meters between each crew person. The crew plotted sites and feature locations on 1:3000-scale aerial photos. This survey method was more flexible and concentrated on locating sites rather than artifacts. Thus, it is no surprise that the Western Hueco Bolson Survey found only 10 prehistoric archaeological sites within the original boundaries of the Tobin Well Project: 41EP378, 41EP379, 41EP380, 41EP1605, 41EP1610, 41EP4703, FB6849, FB6850, FB8008, FB10334. Only one of these sites yielded data for temporal placement. Whalen (1978) suggests a good possibility of intact subsurface remains and potentially dateable features being present. For the time, methods used by the Western Hueco Bolson Survey were state of the art. However, those methods missed a substantial portion of the surface archaeological record within the Tobin Well area.

Phase I Survey

Project 91-14, Phase I, the next survey of the Tobin Well area occurred in 1991, nearly 13 years after the Western Hueco Bolson Survey, at the request of the Army for the proposed expansion of the Hawk Radar Facility. This survey, led by Mark Bentley, utilized a more rigorous survey

method that involved gridding the survey area into 1-kilometer-long north-south transects and dividing each transect into a set number of transect recording units (TRUs). Each transect was 45 meters wide, making crew spacing approximately 15 meters. With 33 TRUs per transect, each TRU was approximately 32 meters north-south by 45 meters east-west. Crew positions were marked by letters with the crew chief always being letter B; the crew member to the left was A and the crew member to the right was C.

The crew chief's primary responsibility was reading the aerial photos and knowing the crew's location at all times. Crew members A and C recorded observations for their areas and for the crew chief who called out what he saw as he walked. Each crew person intensively surveyed the 1 meter he or she walked and the meter to either side, resulting in a 3-meter-wide swath. The 6-meter-wide areas to either side were visually inspected from the line each crew member walked; walking off-line was not permitted unless diagnostic artifacts were present or features were noted. Artifacts or features on-line were intensively recorded; features were measured and artifacts quantified. Off-line artifacts and features were more generally recorded by estimated feature sizes and counts. All observations were recorded on computer key forms and their locations precisely plotted on the 1:3000 aerial photos.

Phase I survey recorded 39 prehistoric archaeological sites within the original 1.51 square-kilometer project area, including 9 recorded during the 1978 survey. Military activity had destroyed one site, 41EP1610. Fifteen sites were assigned temporal designations based on ceramics; the remaining 24 were undetermined. Sites were in shallow erosional loci or areas of built-up dunal sands and in areas of deflation between stable mesquite dunes. Survey records indicate a strong possibility of buried cultural material at some sites and the potential for dateable features. Bentley concluded that military maneuvering had produced a large amount of ground disturbance since the Whalen survey and that this activity may have obliterated or buried some sites. After William took over the Phase II portion of the project, the original 1.51-square-kilometer area was reduced to the current 1.08 square kilometers, leaving out several sites recorded during the earlier surveys. These sites (41EP378 41EP1605, FB6849, FB6850, FB8008, and FB10334) are excluded from further consideration for this report, leaving a total of 33 sites recorded from Phase I survey. This number decreased to 27 sites by combining five Phase I sites into two (41EP4708 and 41EP4713) and excluding site 41EP380, which Phase I survey did not find. Phase II reconnaissance located another 21 sites (including 41EP380), increasing the total number of sites within the project area to 48. Western Hueco Bolson Survey sites were initially recorded with El Paso Centennial Museum site numbers and Phase I sites were recorded with UTM number-letter combinations. When William took over the project, he converted all site numbers to the Fort Bliss (FB) numbering system and assigned FB numbers to new sites.

Phase I survey methods discovered nearly four times the number of artifact clusters (sites) than the Western Hueco Bolson Survey discovered. Several interrelated factors may account for this. First, reducing the spacing between crew members from a variable 45 to 60 meters to 15 meters resulted in

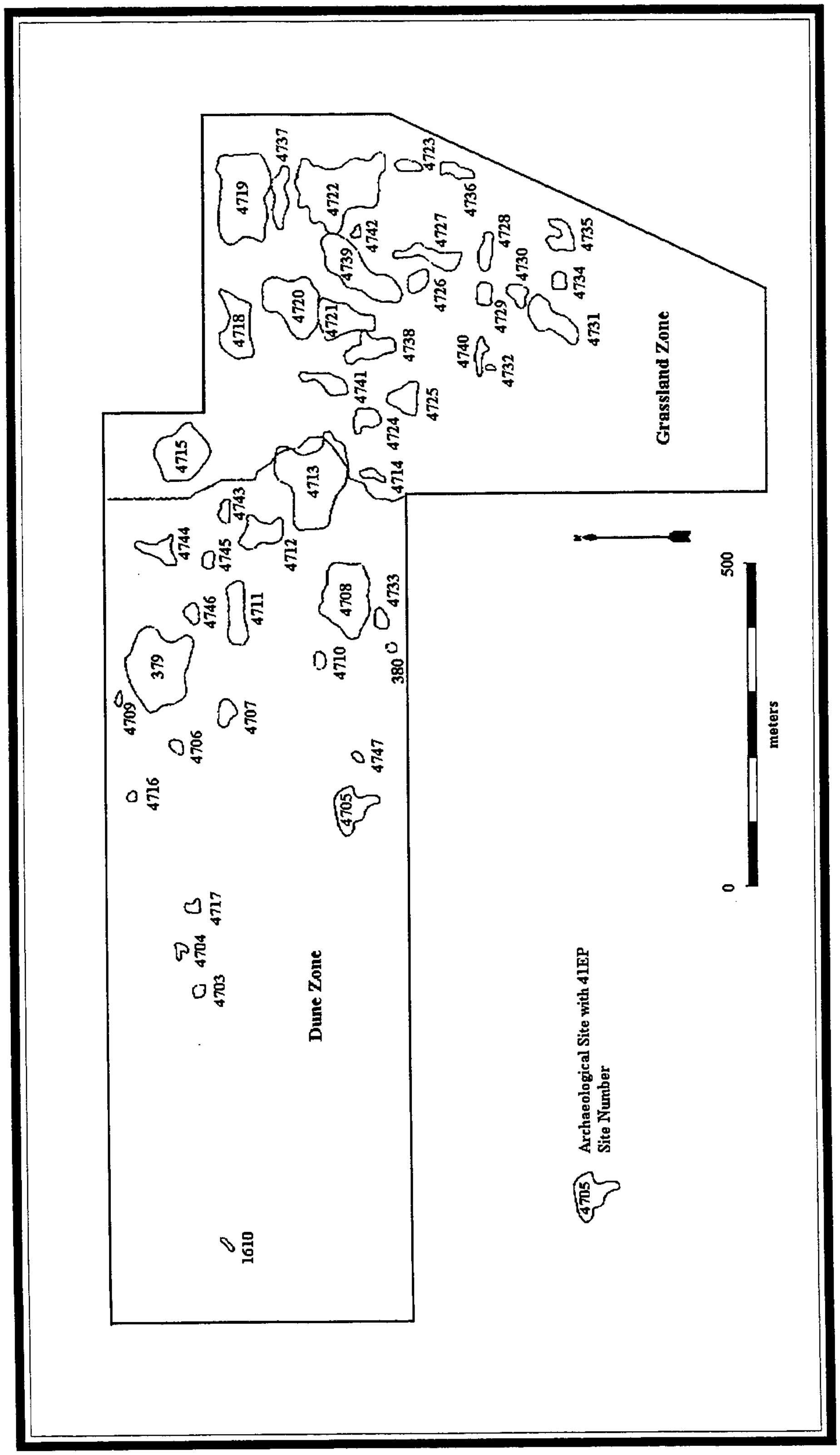

Figure 4.1. Archaeological Sites Recorded during Project 91-14.

crew members inspecting more area. A second factor may have been standardized recording procedures combined with more rigorous survey and gridding methods. A third, but less influential factor may be exposure. Less artifactual material may have been visible on the surface in 1978 than in 1991.

Though Phase I survey explored parts of 4 square kilometers, the analysis used only 2 square kilometers as nearly 99% of the recorded artifacts came from these two. Phase I survey made a total of 207 observations in these 2 square kilometers. Artifact totals for these observations number 1,773 items.

To facilitate analysis of Phase I data, observations and artifacts were divided by geomorphic zones in the project area. A breakdown of the number of observations and number of artifacts by geomorphic zone shows more observations and fewer artifacts recorded for the grassland zone than for the dune zone, and nearly twice as many artifacts were discovered in the dune zone than the grassland zone (Table 4.1). This is probably due to increased visibility of artifacts in dunal areas—artifacts tend to be clustered in interdunal areas where erosion has deflated the ground surface. Grasses, weeds, and areas of deep, windblown sand sheets frequently cover grassland areas and obscure surface items. The increased number of observations is most likely a factor of a large El Paso phase site (FB 6849) north of the present project area.

Table 4.1. Observations and Artifacts in Geomorphic Zones.

Zone	Observations	Artifacts
Grassland	121	649
Dune	86	1,124
Total	207	1,773

Next, the analysis examined the number of observations made and the number of artifacts discovered by individual crew members in each geomorphic zone (Table 4.2). In general, crew members made about the same number of observations for each geomorphic zone. The low number of observations made by Crew Member B is due to the fact that this person was responsible for reading the aerial photos and navigating the crew through the survey area, thus spending less time examining the ground. The number of artifacts discovered by crew members fluctuated by geomorphic zone. Crew Member A found more material in the dune zone than in the grassland zone; Crew Member B found more material in the grassland zone than the dune zone. Finally, Crew Member C consistently found more material overall than Crew Members A or B. The reasons for these variations may be visibility, available light, walking speed, or crew experience. Of these factors, crew experience is probably the single most important; experienced crew members generally find more material than their inexperienced counterparts. This possibility will be examined in more detail below.

Table 4.2. Crew Person Observations

Geomorphic Zone	Crew Person	# of Observations	# of Artifacts
Grassland	A	42	179
	B	32	206
	C	47	264
Dune	A	30	391
	B	21	136
	C	35	597
Total		207	1,773

The number and diversity of features discovered during the survey also show some patterns by geomorphic zone (Figure 4.2). The grassland zone contained eight

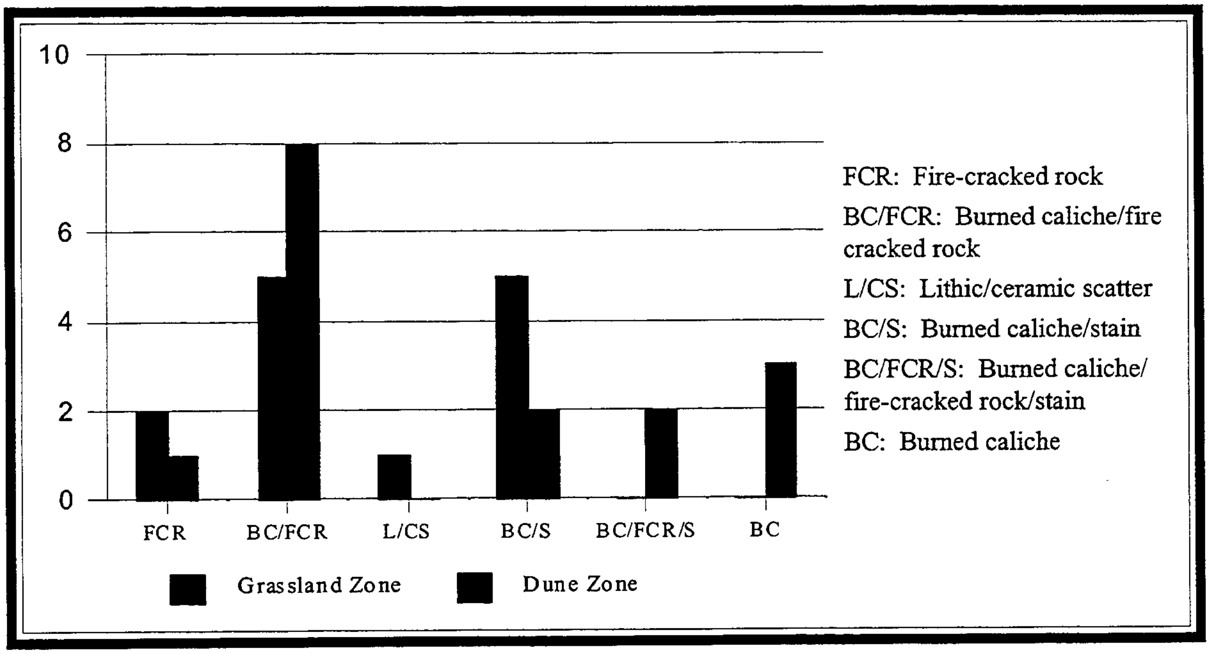

Figure 4.2. Grassland and Dune Zone Features.

features, the majority being burned caliche and fire-cracked rock types. The dune zone contained sixteen features of five different types. Further, stains occurred only within the dune zone, indicating the enhanced visibility within this zone. The low frequency of features in the grassland zone probably means that most material is under a mantle of windblown sand.

Analysis of material type by artifact class shows, not surprisingly, that most lithic debitage comprises either fine-grained materials such as chert and obsidian or very hard macrocrystalline materials such as rhyolite, basalt, and quartzite (Table 4.3). Most ground stones and burned rocks are coarse-grained materials such as quartzite, limestone, rhyolite granite, and basalt. High incidences of coarse-grained material in the burned rock category may indicate a large amount of recycling of ground stone pieces into hearth rock.

To examine the possibility further that crew experience may have been a factor in the discovery of material, the number of artifacts by type was tabulated by geomorphic zone (Table 4.4). In the dune zone, crew member C found the most types while crew members A and B found nearly equal amounts of pottery, debitage, tools, and cores; crew member A noted more ground stone, burned rock, and features than crew member B. In the grassland zone crew members A and B found almost equal amounts of material except debitage and burned rock. Again, crew member C found more material than A and B, but the difference is not nearly as large as in the dune zone. When looking at material type by crew member for the two geomorphic zones, more differences are apparent. In the dune zone crew member C found more of the various materials while A and B found almost equal amounts (Table 4.4). In the grassland zone, however, all crew members

Table 4.3. Artifact Materials.

Material Type	Artifact Class						
	Debitage	Tool	Core	Hammer-stone	Ground Stone	Burned Rock	Total
Basalt	40	2	1	0	29	62	134
Chert	35	4	3	0	0	4	46
Granite	0	0	0	1	29	47	77
Limestone	6	0	0	2	2	18	28
Obsidian	5	0	0	0	0	0	5
Quartzite	27	0	0	3	33	76	139
Rhyolite	39	0	2	6	1	38	86
Sandstone	0	0	0	0	8	4	12
Total	152	6	6	12	102	249	527

found about the same amount of the different materials with variations noted for chert and quartzite. For artifact type, crew member C consistently found more items per type in the dune and grassland zones than crew members A and B. For material type, the discovery results were more variable, with crew member C finding more of most types in the dune and grassland zones, while crew member A in the grassland zone found more chert.

Table 4.4. Artifact Types per Crew Person.

Artifact Type	Crew Person		
	A	B	C
Dune Zone			
Burned rock	348	117	463
Core	0	1	3
Debitage	7	9	19
Ground stone	18	2	12
Pottery	7	5	83
Tool	4	0	4
Features	7	1	8
Total	391	135	592
Grassland Zone			
Burned rock	51	102	78
Core	1	0	2
Debitage	47	18	53
Ground stone	18	25	31
Pottery	57	56	91
Tool	3	2	6
Features	2	3	3
Total	**179**	**206**	**264**

Crew members B and C both had more than 20 years of experience in the Jornada Mogollon region; crew member A had fewer than 2 years. Keeping in mind crew member B's recording and navigating responsibilities, it appears that experience played a role in the discovery of different artifact and material types.

Phase II Survey

In March of 1992, Jerry William (project director) initiated Phase II of the Tobin Well Project, which involved mapping, surface collection, and subsurface testing. Upon beginning the mapping some artifacts and sites could not be found, but William's field notes indicate that a majority were found and often were more complex and larger than originally recorded. This prompted William to conduct a resurvey of the project area with a crew of five. Crew spacing was 5 to 10 meters between each crew member. Site locations, boundaries, and feature locations were plotted on 1:3000-scale aerial photos. Site information was recorded on Fort Bliss site survey forms; no collections were made. Unfortunately, no survey records were kept during this reconnaissance and there is no data set to make comparisons between the two surveys. Suffice it to say that a combination of

survey methods and crew experience is most likely responsible for missing a substantial portion of the archaeological surface record during Phase . The survey method utilized during Phase I had 15-meter spacing between crew members and stressed more intensive recording of on-line items than off-line items; off-line areas received only a cursory look compared to on-line areas. Phase II used spacing of 5 to 10 meters and allowed for the examination of almost all areas between dunes, and it is no surprise that the crews found sites that were larger and more complex than originally recorded.

Discussion

Survey methodology is crucial in properly budgeting time and money for compliance projects undertaken at Fort Bliss. Several previous projects have suffered with the problem of conducting a survey by Fort Bliss standards and then finding during Phase II mapping and surface collection that extra time had to be devoted to recording and mapping more artifacts.

The Borderstar 85 Survey (Seaman et al. 1988) on the western slopes of the Jarilla Mountains several miles north of the Tobin Well Project area was conducted in a similar manner. Geomorphically, that project area is similar to Tobin Well, though the area covered is larger. Borderstar 85 also used a survey system similar to that utilized at Tobin Well (systematic transect survey, though the interval for Borderstar 85 was 33 meters). Seaman et al. (1988: 140) estimate that their Phase I survey underrecorded the surface archaeological record by 67% because of the systematic sampling and recording methodology employed and the geomorphic character of the project area. The Tobin Well survey employed similar procedures, but utilized smaller crew spacing. No comparative analysis of the Borderstar 85 and Tobin Well data was conducted, although analysis of the Tobin Well survey data indicates a similar problem of underrecording dispersed archaeological material and emphasizing aggregated remains.

Thus, because of the nature of the systematic survey method, site size increased and the number of collections also increased causing logistical and time problems. This problem was especially acute at Tobin Well. The overall testing strategy had to be abandoned because of the extra time spent mapping and surface collecting. As a result, most sites were not tested and testing procedures for those sites that were examined were not consistent, causing further problems during the write-up and analysis phase.

Summary

The Tobin Well Archaeological Project originally involved the survey of a 1.51-square-kilometer area on the western edge of the Hueco Bolson. Three surveys conducted in the area produced different results. The Western Hueco Bolson Survey in 1978 noted only ten sites within the project area, whereas Project 91-14 Phase I survey in 1991 recorded 39 sites. Analysis of that survey data indicate that a combination of

survey methods and crew experience affected the subsequent results of the survey. Crew spacing and systematic on-line and off-line recording procedures greatly affected the number of items discovered on survey. Crew experience, to a lesser extent, also influenced the amount and types of artifacts discovered. Upon Project 91-14 Phase II reconnaissance in 1992, several sites were found to be larger and contain more material than previously recorded on survey. The reconnaissance recorded 21 sites within the project area, which, with the sites from the two preceding surveys, brings the total to 48 prehistoric archaeological sites. The key to different survey results appears to be crew spacing. Western Hueco Bolson Survey crews were spaced between 45 and 60 meters apart, Project 91-14 Phase I crews were spaced between 15 and 30 meters, and Phase II crews were spaced between 5 and 10 meters apart. A general rule of surveying states that the closer the crew spacing the more likely features and artifacts will be found.

Another factor influencing the discovery of sites is the dynamic nature of the bolson. Episodes of erosion and deposition are certain to affect what the archaeologist sees on the ground; this is especially true in the Hueco Bolson. Some sites from this project were eroded on the surface and others were buried by up to 60 centimeters of eolian fill.

5

MAPPING AND SURFACE COLLECTION

by

Chris Lowry

This chapter outlines the methods used, analyses performed, and results obtained from mapping and surface collection for the Tobin Well Archaeological Project 91-14. The information presented in this chapter is divided into two parts. The first part contains general descriptive information on mapping and surface collection procedures followed by summaries of the artifact material recovered and surface feature information. The second part presents an in-depth analysis of the Tobin Well surface assemblage followed by a discussion of the results and their meaning in the context of the theoretical expectations proposed in Chapter 3.

Methods

During mapping, project crew members marked all site boundaries with flagging tape, outlined features with nails and flagging tape, and marked all surface artifacts with pin flags. Following these steps, they used an electronic distance measurer (EDM) to plot the provenience of each surface artifact (Figure 5.1) and feature, and as an aid in mapping site boundaries, dunes, and general elevations. All surface artifacts except burned caliche were collected. Artifacts within features with good integrity were left in place for detailed feature diagrams. Collected artifacts were placed in plastic bags and assigned individual artifact codes and catalog numbers. Site mapping included detailed elevation readings to produce contour maps. Site datum points were shot in with the EDM.

The total number of surface artifacts mapped within the Tobin Well project area was 3,610, including 125 isolated finds (Figure 5.1). Table 5.1 summarizes the number of artifacts per site by general artifact type. These types collapse several individual artifact classes used at Fort Bliss into more general artifact categories. These artifact categories are:

- Debitage
- Flake
- Utilized flake (includes utilized debitage and utilized flakes)
- Tool (includes unimarginal retouch, bimarginal retouch, unifacial retouch, bifacial retouch, and projectile points)
- Core
- Hammerstone (includes angular and rounded hammerstones)

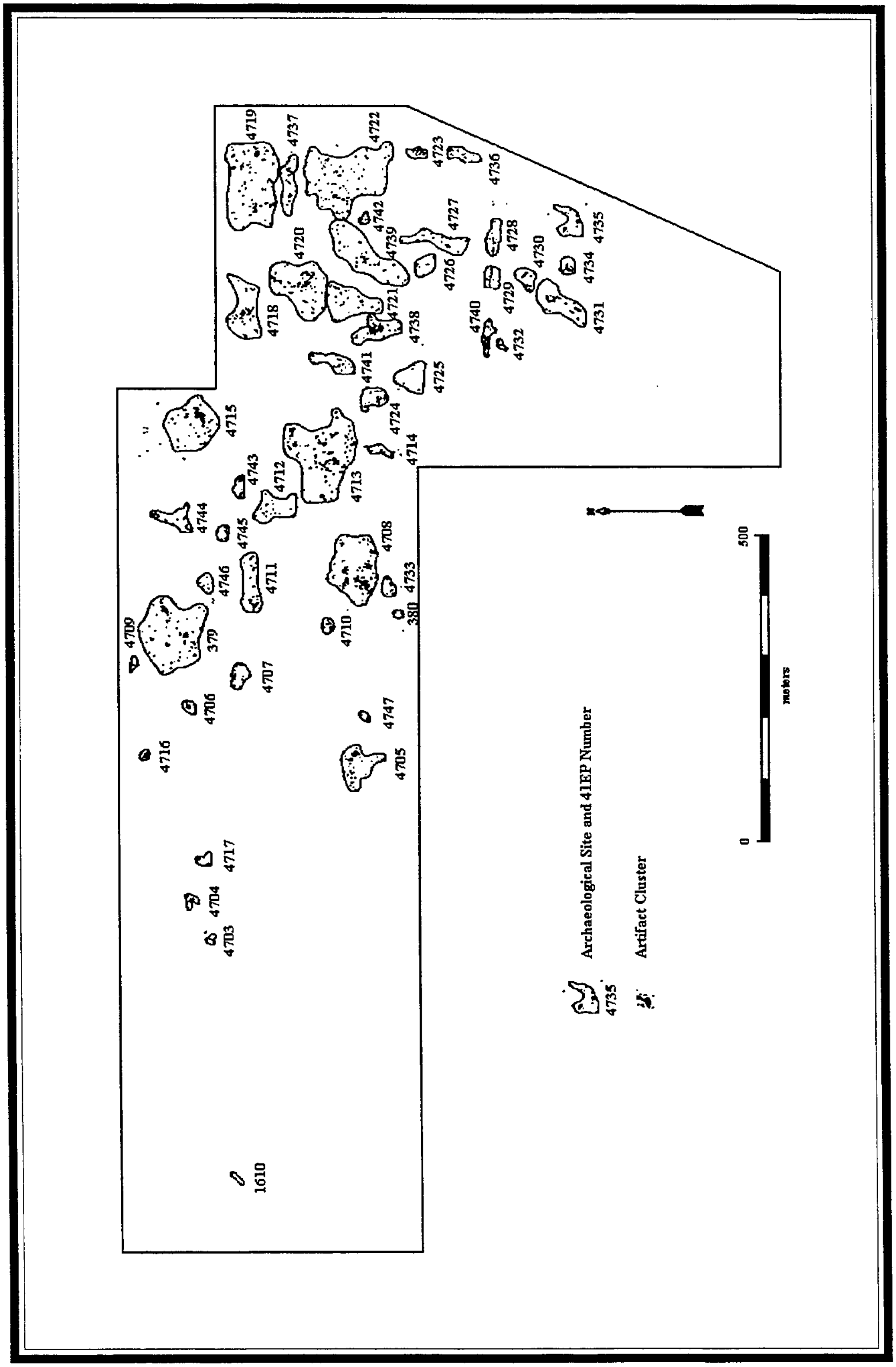

Figure 5.1. Distribution of Surface Artifacts, Tobin Well Project 91-14.

Table 5.1. Surface Site Data.

Site	Size (sq. m)	Number of Features	Debitage	Flake	Utilized Flake	Tool	Core	Hammerstone	Ground Stone Tool	Ground Stone Fire-Cracked Rock	Undifferentiated Brownware rim	El Paso Polychrome	Other Ceramics	Fire-Cracked Rock	Burned Caliche	Total
41EP379	9,880	6	3	17	6	1	4	2	4	22	3	0	0	71	400	533
41EP380	190	0	1	0	1	1	0	0	0	0	0	0	0	0	0	3
41EP4703	200	0	0	0	0	0	0	0	0	0	0	0	0	5	15	20
41EP4704	345	1	0	0	0	0	0	1	4	6	2	0	0	2	36	51
41EP4705	2,950	1	4	6	10	0	1	2	5	8	1	0	0	11	31	79
41EP4706	370	2	0	0	0	0	0	0	0	2	0	0	0	14	8	24
41EP4707	920	1	0	1	1	0	1	0	0	1	5	0	0	3	13	25
41EP4708	7,075	2	9	56	13	0	1	1	5	37	109	3	0	30	248	512
41EP4709	165	1	0	0	0	0	0	0	1	5	0	0	0	3	2	11
41EP4710	410	2	1	0	0	0	0	0	0	0	0	0	0	0	41	42
41EP4711	2,625	2	0	10	3	0	0	1	1	24	1	0	0	56	40	136
41EP4712	2,420	0	0	2	2	0	0	0	1	4	1	1	0	9	2	22
41EP4713	11,000	1	2	26	8	0	2	0	4	20	2	4	0	63	62	193
41EP4714	490	1	0	0	1	1	2	0	0	2	0	0	0	8	0	14
41EP4715	5,525	1	4	55	7	1	0	1	0	9	79	8	14	46	44	268
41EP4716	200	0	138	55	0	0	6	0	0	0	0	0	0	0	0	199
41EP4717	405	1	1	0	1	0	0	0	0	4	0	0	0	10	8	24
41EP4718	3,750	0	0	5	1	0	1	0	1	1	27	1	0	16	20	73
41EP4719	10,220	1	14	55	10	1	3	1	2	33	67	40	25	25	26	302
41EP4720	6,130	0	1	14	2	0	0	2	1	5	29	9	0	1	35	99
41EP4721	3,650	0	0	7	1	0	0	0	0	8	2	0	0	5	22	45
41EP4722	11,000	0	7	16	3	1	0	1	0	11	18	3	3	13	54	130
41EP4723	170	0	1	0	0	0	0	0	1	9	2	1	0	3	16	33
41EP4724	1,170	0	11	7	0	0	1	0	0	2	4	0	0	5	25	55
41EP4725	1,960	1	0	2	1	0	0	0	0	2	0	1	0	0	0	6
41EP4726	1,100	0	0	3	0	0	0	0	0	0	0	0	0	5	1	9
41EP4727	2,055	0	0	5	0	0	0	0	0	0	0	0	0	2	13	20
41EP4728	454	0	4	5	0	0	0	0	0	4	3	0	0	17	4	37
41EP4729	160	1	18	2	0	0	0	0	0	3	0	0	0	28	0	51
41EP4730	500	0	0	0	0	0	0	0	0	2	0	0	0	1	5	8
41EP4731	1,675	4	1	3	1	0	1	0	0	2	0	0	0	4	19	31
41EP4732	80	1	1	1	1	0	0	0	0	1	0	0	0	5	7	16
41EP4733	560	1	1	0	0	0	0	0	0	5	0	0	0	2	11	19

(Continued on next page.)

Table 5.1. Surface Site Data (Continued).

Site	Size (sq. m)	Number of Features	Debitage	Flake	Utilized Flake	Tool	Core	Hammerstone	Ground Stone Tool	Ground Stone Fire-Cracked Rock	Undifferentiated Brownware rim	El Paso Polychrome	Other Ceramics	Fire-Cracked Rock	Burned Caliche	Total
41EP4734	525	1	1	0	1	0	0	1	1	1	3	0	0	2	4	14
41EP4735	1,510	1	3	1	0	0	0	0	0	2	5	4	1	3	24	43
41EP4736	1,200	0	0	1	0	0	0	0	0	1	18	10	1	0	0	31
41EP4737	2,340	0	0	6	0	0	2	0	2	2	16	11	1	4	2	46
41EP4738	2,230	0	6	11	2	0	0	1	3	20	5	1	0	35	97	181
41EP4739	6,000	0	2	3	0	0	1	0	1	5	3	0	0	9	28	52
41EP4740	620	0	1	3	2	0	0	1	0	7	0	0	0	9	10	33
41EP4741	1,575	0	0	1	2	0	2	2	0	3	1	0	0	4	13	28
41EP4742	220	0	0	1	0	0	0	0	0	0	2	0	0	1	7	11
41EP4743	515	0	1	0	0	0	1	1	0	1	1	0	0	4	13	22
41EP4744	1,420	0	3	1	1	0	3	0	0	3	1	0	0	6	11	29
41EP4745	430	0	0	0	0	0	0	0	0	0	0	0	0	6	1	7
41EP4746	630	0	0	1	1	0	1	0	0	2	0	0	0	1	0	6
41EP4747	210	0	0	0	0	0	0	0	0	10	0	0	0	6	1	17
Total	109,229	33	239	382	82	6	33	18	37	289	410	97	45	553	1,419	3,610

- Ground stone tool (includes whole mano, mano fragment, whole metate, metate fragment, and mano/metate)
- Ground stone fire-cracked rock (includes other ground stone that shows evidence of burning)
- El Paso brownware (includes undifferentiated brownware and El Paso Brown rim sherds)
- El Paso polychrome (includes El Paso Bichrome, El Paso Bichrome rim, El Paso Polychrome, and El Paso Polychrome rim sherds)
- Other ceramic (includes Mimbres Boldface Black-on-white, Mimbres Boldface rim, Mimbres Transitional Black-on-white, Mimbres Transitional rim, Mimbres Classic Black-on-white, Mimbres Classic rim, Mimbres Corrugated, other Mimbres, Chupadero Black-on-white sherds)
- Fire-cracked rock
- Burned caliche

The following standard Fort Bliss site criteria (De Garmo 1992) were used to define sites:

- More than three different artifact types in a 30-meter area
- More than three different raw material types in a 30-meter area
- A single feature

- More than 10 artifacts of a single type within 15-meter area

Several sites have extremely large surface areas that appear to correspond with increased artifact numbers and diversity (Table 5.1). Such sites probably represent multiple occupations through time that have been overlaid and overlapped by reuse of the location or geomorphological processes. Another fact illustrated in the summary data is the large number of sites with few artifacts and small site areas. Such locations indicate a redundant character to the archaeological record and may be related to a more general pattern of land use. Further, a notable difference exists between sites with large quantities of debitage and sites with large quantities of ceramics. A difference also exists in sites with high incidences of debitage versus flakes. Such locations may represent specialized activities at different locations, that is, core reduction locations versus gathering and/or processing locations. Brownware sherds are by far the most common ceramics found within the project area. Also of note is the nearly threefold increase in burned caliche versus fire-cracked rock that may indicate a difference in the type of activity conducted around these features.

One-hundred and twenty-five isolated artifacts were collected during the surface collection at Tobin Well (Table 5.2). Of note is the equal number of tools found within sites and as isolated occurrences and the high incidence of ground stone tools. This weak pattern may suggest differential use of these types of artifacts away from site locations. However, because the sample of isolated artifacts is small and confined to a small area, the pattern may be spurious. Not surprisingly, brownware ceramics and fire-cracked rock are the most numerous isolated artifacts.

Table 5.2. Isolated Artifacts.

Artifact Type	Quantity
Angular debitage	3
Flakes	24
Utilized flakes	7
Tools	6
Cores	1
Hammerstones	5
Ground stone fire-cracked rock	8
Ground stone tools	15
FCR	31
Undifferentiated brownware	17
Polychrome	3
Other ceramics	5
Total	125

Because the presence of fire-cracked rock or burned caliche concentrations and/or the presence of burned sand or a stain defines most features, most are inferred to represent the remains of prehistoric hearths. Surface hearths ($N = 43$) range in size from 25 centimeters to 25 square meters with an average size of 5.45 square meters (Table 5.3). The large area of surface hearths is due to the scattered nature of the fire-cracked rock and/or burned caliche surrounding the feature. Because these features were not tested, feature size is an approximation only. The most common artifacts associated with surface features are chipped stone, ground stone, and ceramic sherds. Ground stone is primarily found as fragments and may indicate recycling as hearth rock. No outstanding pattern is apparent; Chapter 8 provides a more detailed analysis of features and artifact associations.

Table 5.3. Surface Feature Data.

Site #	Fea. #	Feature Type	Feature Size	Associated Artifacts
41EP379	1	Burned caliche/fire-cracked rock scatter	50-cm diameter	None
41EP379	2	Burned caliche scatter	12 sq. meters	None
41EP379	3	Burned caliche scatter	4 sq. meters	Flake
41EP379	4	Burned caliche scatter	1 sq. meter	None
41EP379	5	Burned caliche/fire-cracked rock scatter	1 sq. meter	None
41EP379	6	Burned caliche/fire-cracked rock scatter	22 sq. meters	Debitage and ground stone
41EP4704	7	Burned caliche/fire-cracked rock scatter	1 sq. meter	Ground stone
41EP4705	9	Burned caliche/fire-cracked rock stain	Unknown	Ground stone
41EP4706	10	Burned caliche/fire-cracked rock scatter	50-cm diameter	Ground stone
41EP4706	11	Stain	25-cm diameter	None
41EP4707	12	Burned caliche/fire-cracked rock scatter	1 sq. meter	Ground stone
41EP4708	13	Burned caliche/fire-cracked rock scatter	6 sq. meters	Ground stone, core, ceramics
41EP4708	14	Burned caliche scatter	1 sq. meter	Debitage
41EP4709	15	Fire-cracked rock scatter	1 sq. meter	None
41EP4710	16	Burned caliche scatter	4 sq. meters	None
41EP4710	17	Burned caliche scatter	2 sq. meters	Debitage
41EP4711	18	Fire-cracked rock scatter	1 sq. meter	Hammerstone
41EP4711	19	Burned caliche/fire-cracked rock scatter	6 sq. meters	Debitage
41EP4713	20	Stain	Unknown	Military trash
41EP4714	21	Burned caliche/fire-cracked rock w/stain	25 sq. meters	Flakes, ground stone, ceramics
41EP4715	22	Burned caliche/fire-cracked rock w/stain	25 sq. meters	Debitage, flakes, ground stone, ceramics
41EP4716	23	Lithic scatter	12 sq. meters	Debitage, flakes, cores
41EP4717	24	Burned caliche/fire-cracked rock scatter	75 cm diameter	Debitage, flakes, ground stone
41EP4719	25	Stain	10 sq. meters	Debitage, flakes, ground stone, ceramics
41EP4725	34	Stain	50-cm diameter	Ground stone
41EP4729	35	Fire-cracked rock scatter	Unknown	Debitage, flakes, ground stone
41EP4731	36	Stain	4 sq. meters	Debitage, flakes, ground stone, ceramics
41EP4731	37	Stain	4 sq. meters	Debitage, flakes, ground stone, ceramics
41EP4731	38	Stain	1 sq. meter	Debitage, flakes, ground stone, ceramics
41EP4731	39	Stain	1 sq. meter	Debitage, flakes, ground stone, ceramics
41EP4732	40	Stain	Unknown	None
41EP4733	41	Burned caliche/fire-cracked rock scatter	75-cm diameter	None
41EP4734	42	Stain	2 sq. meters	Debitage, flakes, ceramics
41EP4735	43	Stain	1 sq. meter	Debitage, flakes

Assemblage Analyses

Though this project did not use distributional survey techniques, most of the surface archaeological record within the Tobin Well project area is thought to have been recorded. Therefore, analyses used artifact distributions to isolate patterns of variability between artifact types that may aid in understanding the organization of the past culture(s) that inhabited the area. This section examines the occupational history of the project area through analysis of assemblage variability. It also examines the composition of the various site assemblages to aid in identifying similarities or differences. Further, these analyses may allow for the recognition of functional locations or site types defined in Chapter 3.

Methods

Surface data collected for the Tobin Well Project include detailed analytical information and provenience on 2,191 artifacts. Only the burned caliche ($N = 1{,}419$), which was plotted in the field but not analyzed, has no detailed analytical data. Because of the small project area (only 1.08 square kilometers) comparisons with other topographic areas are not possible. Further, because this analysis attempted to isolate general patterns of artifact variability across the landscape, the analysts felt they should examine the spatial scale of the site. Scale here is used in the spatial or size sense to examine variability among artifact classes with reference to space on the landscape. The Fort Bliss standard site definition arbitrarily defines site scale and represents a relatively large scale. Keep in mind that this analysis examines gross, but general level patterns of landscape use. Larger sample sizes over larger areas need to be conducted and more fine-grained spatial analyses need to be utilized before an increased understanding of landscape patterning can be reached (see Ebert 1992).

The analysis conducted on this database involved looking at assemblage content followed by a closer look at the composition of site assemblages. The analysis utilized sites defined during the project. Forty-seven sites used as units of analysis had their artifact frequencies tabulated and reduced to thirteen general artifact types (see Table 5.1).

The first analysis examined the site data matrix. In order to isolate patterns that might be present within this data matrix, several analyses were run varying the number of artifact classes. The most provocative pattern used the 47 cases and 13 variables. The site data matrix was converted to normalized chi-square scores to adjust for sample size differences between the artifact classes. A singular value decomposition (SVD) then utilized the ANTANA statistical package (Harpending and Rogers 1985) on this normalized matrix. The SVD program extracts the principal components from a matrix of data values. This amounts to taking a large number of data values and reducing them in geometric space to a smaller number of vectors that account for a large portion of the variance among the classes and cases.

Results

Analysis of the site data matrix resulted in a four-singular-value solution believed to account for a large portion of the variance. Though exact proportions of the variance are not reported, the relative size for each singular value gives a clue to the amount of vari-

ance that each vector represents. Table 5.4 summarizes the singular values and the loadings for each vector in the solution using 13 artifact classes. The results indicate four dimensions that account for most of the variance:

1. A pattern of utilized flakes, ground stone fire-cracked rock, fire-cracked rock, burned caliche, and unidentified brownware ceramics versus all other artifact types, especially debitage, flakes, and cores
2. A pattern of debitage and fire-cracked rock versus all other artifact types, especially ceramics
3. A pattern of utilized flakes, tools, cores, hammerstones, ground stone tools, ground stone fire-cracked rock, fire-cracked rock, and other ceramics versus unidentified brownwares, burned caliche, flakes, and debitage
4. A pattern of El Paso Polychrome, other ceramics, ground stone tools, hammerstones, cores, tools, and utilized flakes versus flakes, fire-cracked rock, and brownwares

Table 5.4. Vector Loadings for Site Data.

Singular Value	**39.53**	**30.02**	**23.30**	**16.67**
Artifact Class	**Dimension 1**	**Dimension 2**	**Dimension 3**	**Dimension 4**
Debitage	-34.95	7.71	-1.97	0.60
Flakes	-8.84	-5.59	-2.88	-4.18
Utilized Flakes	1.11	-1.77	3.29	2.35
Tools	-0.03	-1.02	4.59	5.24
Cores	-2.11	-0.40	4.50	5.87
Hammerstones	0.16	-0.86	4.37	5.49
Ground stone tools	0.88	-0.12	3.73	4.86
Ground stone fire-cracked rock	3.17	-1.15	6.75	0.68
Fire-cracked rock	3.65	1.91	14.48	-9.34
Burned caliche	15.13	15.65	-9.70	2.18
EP brownware	1.85	-18.29	-9.47	-3.35
EP Polychrome	-0.78	-12.94	0.58	5.48
Other Ceramics	-0.69	-7.24	2.51	2.29

Dimension 1, with a singular value of 39.53, accounts for a large part of the total variance and opposes all types of burned rock with all other artifact types, with the heaviest negative loadings on debitage and flakes. This dimension may indicate the differential utilization of features apart from other activities. The heavy negative loadings on debitage and flakes may show that primary core reduction took place away from other activity areas.

Dimension 2, with a singular value of 30.02, accounts for the next largest portion of the variance in the solution and opposes debitage, fire-cracked rock, and burned caliche with all other artifact types. Here, there is an indication that certain feature activities, especially involving those using burned caliche as hearth rock, are distinctly different from other feature and nonfeature activities. Thus, this vector suggests specialized task or logistical group activities.

Dimension 3, with a singular value of 23.30, accounts for a smaller part of the total variance in the solution and opposes utilized flakes, tools, cores, hammerstones, ground stone tools, ground stone fire-cracked rock, fire-cracked rock, and other ceramics with debitage, flakes, burned caliche, and undifferentiated brownwares.

Dimension 4, with a singular value of 16.67, accounts for the smallest part of the variance for the solution and, again, most of the tool artifact types with flakes, fire-cracked rock, and undifferentiated brownwares.

Dimensions 3 and 4 are interesting in the distinct opposition between fire-cracked rock (Dimension 3) and burned caliche (Dimension 4). Again, there is a hint of differential feature activity. Another interesting aspect is the positive loadings for tool artifacts such as cores, utilized flakes, hammerstones, and ground stone tools in these two dimensions. Such a pattern may reflect caching or storage of reusable items at locations away from feature-related activities. A final factor is the positive loading in Dimension 4 for El Paso Polychrome sherds. This is the only strong positive loading for this type and it may indicate a temporal distinction for these assemblages.

Discussion

In general, the results of the SVD analysis are encouraging. The two patterns revealed in this analysis are (1) fire-cracked rock and burned caliche versus all other artifact classes and (2) tool artifacts versus various other types. Sample size may account for the burned caliche-fire-cracked rock pattern as these two classes make up a large proportion of the total artifacts. The tool associations may be either a cultural phenomenon (for example, caching behavior) or the result of geomorphic processes or site reuse and/or overlay. These patterns may also represent functional and/or seasonal differences in the use of locations emphasizing fire-cracked rock.

Camilli et al. (1988) used a similar analysis for the West Mesa surface lithic assemblages. The results of that project, however, were substantially different from the results obtained at Tobin Well. Several factors account for this. First, Camilli's analysis used clusters of spatially related artifacts as units of analysis and utilized a classification of 14 lithic artifact categories. Tobin Well used 13 artifact classes that included all types of artifacts and used sites as units of analysis. Second, Camilli's analysis involved survey units covering a larger area and including nearly six times the artifacts. Though not directly comparable, the results of Camilli's analysis are interesting at a more gross level of patterning.

Camilli et al. (1988), looking at the general occupational history of the West Mesa landscape, note four distinct assemblage patterns. The first opposes chipped stone debris with ground stone tools, while the second opposes fire-cracked rock with ground stone fire-cracked rock. The third pattern opposes flakes and utilized flakes with formal tools. The last pattern opposes cores and hammerstones with flakes, ground stone fire-cracked rock, and debitage. Camilli et al. (1988: 8-6–8-14) argue that the first pattern is a product of geomorphological processes based on size differences between the chipped stone and ground stone pieces. Patterns noted for the Tobin Well data are most likely affected by these same processes. Camilli et al. (1988: 8-14) interpret the second pattern as an indication of heavy recycling of ground stone for hearth rock. They interpret the third pattern as a difference between where tools were discarded with a lack of utilized flakes versus areas where utilized flakes, flakes, and debitage were used and discarded. Thus, this may point to areas of expedient (on the fly)

tool use and areas where curated tools were carried, possibly used, then discarded, cached for later use, or lost. Camilli et al. (1988: 8-14–8-15) argue for a switch in tool use strategies possibly "due to anticipated change in tool requirements." Finally, Camilli interprets the last pattern as either a result of geomorphic processes or a representation of caching for later anticipated use.

Overall, Camilli et al. (1988: 8-17) find that postdepositional processes have altered the surface archaeological record to the point that sites as functional activity areas are not discernible. Their analysis points to interesting patterns, one of which is seen at Tobin Well. For example, the opposition of reusable artifact classes (hammerstones, tools, and cores) with all other artifact types, including flakes and debitage is similar to patterns noted by Camilli et al. (1988) at a gross level. The pattern similarities stop here, however. None of the other patterns noted was found in the Tobin Well data. Given the similar environmental characteristics of the two project areas (both are coppice dune-sand grassland areas) some pattern similarity was expected.

Binford (1992) conducted a similar assemblage content analysis for some of the GBFEL-TIE project sites in the central Tularosa Basin. Her analysis utilized artifact type classes similar to those used for the Tobin Well analysis. Binford's (1992: 161) analysis identified fire-cracked rock as the variable most sensitive to assemblage variation. In general, if debitage is more frequent, then fire-cracked rock is less frequent; this dimension accounted for a substantial amount of the solution variation. The next largest portion of the variance indicated that if fire-cracked rock is less frequent, then ceramics are more frequent. The remaining variance indicates that if fire-cracked rock frequency is high, then ground stone frequency is low. Binford (1992: 161) feels that these dimensions "are good indicators of variability in human systems organization." When activities involving lithic reduction or the use of ceramics are primary, the use of heat-related features is secondary. Further, if heat-related feature activity is primary, ground stone appears to be secondary.

Binford (1992) also conducted the same analysis using various lithic artifact classes grouped into activity sets. This analysis indicated that inverse relationships existed between: "(a) core reduction and ground stone, (b) ground stone and tools, and (c) formal tool manufacture and ground stone" (Binford 1992: 161). Binford believes these relationships indicate that at areas where grinding is primary, lithic activities, and formal tool use and discard is secondary. These relationships may be indicating "functional, seasonal, or temporal variability in the use of the study area" (Binford 1992: 161).

Conclusions

Several factors may be responsible for the results of the Tobin Well artifact assemblages and the subsequent inability to define occupational histories for the project area. First, extensive collecting has occurred for more than 100 years (probably longer) in the vicinity of the project area. Such long-term changes to the archaeological surface record will almost certainly have an effect on analytical results.

Second, the project area is quite small (1.08 square kilometers). Though it may be possible to infer past system activities from just a portion of the system's landscape, such a small area is not likely to accurately represent much of a system's past landscape use,

especially given the first factor discussed above. A more accurate picture might be found by comparing geomorphic areas (dunes versus grasslands) and geographic areas (mountains versus basins). Larger samples of artifacts from larger survey areas may also aid in defining the types of activities that took place on the edge of the desert basins. Following these guidelines, it may be possible to reconstruct past systems of land use throughout the region. Camilli et al. (1988) and Binford (1992) both utilized extensive databases for large areas for their analyses of assemblage variation.

It is interesting to note that both the Tobin Well analysis and Binford's analysis of the GBFEL-TIE area indicate that fire-cracked rock is a strong conditioning variable. Further research should emphasize the study of fire-cracked rock and its potential uses, as well as investigate feature variability across the landscape.

Referring to the theoretical expectations outlined in Chapter 3, little can be said about defining actual types of sites. The surface record suggests the existence of both residential and logistical-foraging sites and some special use areas. Several sites show indications of reoccupation, possibly several times in the past. It is likely that some sites represent logistical or foraging locations based on size of assemblage and area. Caching of certain artifact types may be a pattern found at Tobin Well and other areas and may point to sites that are residential in nature or to areas used for logistical processing.

The various postdepositional processes, however, that have altered the archaeological record of the Hueco Bolson for more than 10,000 years make defining site types problematical until larger, ecologically diverse areas are studied. The analysis of the Tobin Well surface material indicates that variability between artifact classes is present and that this variability may be conditioned by organizational differences of past cultural systems.

Assemblage Composition

The design of the second analysis carried out on the Tobin Well surface data focused on identifying similarities or differences between the content of various site assemblages. To facilitate this analysis, the same matrix used in the assemblage content analysis was subjected to a hierarchical cluster analysis using Ward's method. The matrix was normalized using the chi-squared values derived from the first analysis (Figure 5.2). The design of the second analysis carried out on the Tobin Well surface data focused on identifying similarities or differences between the content of various site assemblages. To facilitate this analysis, the same matrix used in the assemblage content analysis was subjected to a hierarchical cluster analysis using Ward's method. The matrix was normalized using the chi-squared values derived from the first analysis (Figure 5.2).

Results

The results of the assemblage composition analysis indicate a six cluster solution based on the relative density and diversity of artifacts (Table 5.5). Cluster 1 contains 22 members and represents locations that are primarily low density and low diversity. Features appear to dominate this cluster with

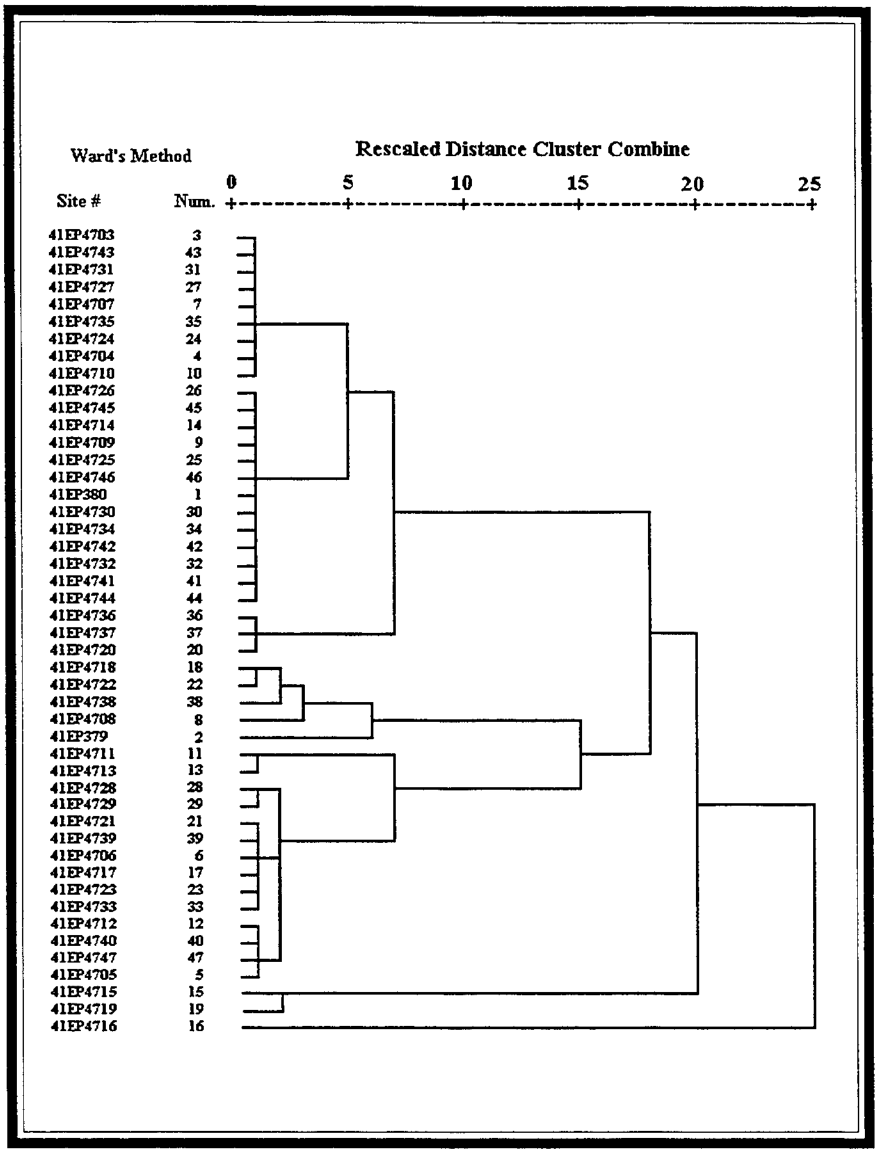

Figure 5.2. Site Composition.

42.4% of the total surface features recorded. Only tools, cores, and hammerstones show relatively high percentages; all other types show relatively low percentages. This cluster may indicate low density, feature-related activities such as traveling camps, hunting stands, or logistical or foraging locations.

Low relative artifact density similar to Cluster 1 characterizes Cluster 2, which contains three members. However, relatively high percentages of ceramic sherds, especially El Paso polychrome types, and a complete lack of features mark this cluster as different from the others. Percentages of other artifact types are, in general, lower than in Cluster 1. Locations in this cluster may be similar to those in Cluster 1, but do not center around features. Such areas may represent foraging or logistical locations.

Table 5.5. Artifact Types per Cluster.

	Cluster 1 (22 members)		Cluster 2 (3 members)		Cluster 3 (7 Members)		Cluster 4 (12 Members)		Cluster 5 (2 Members)		Cluster 6 (1 Member)		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Features	14	42.42	0	0	11	33.33	6	18.18	2	6.06	0	0	33	99.99
Debitage	23	9.62	1	0.42	27	11.29	32	13.38	18	7.53	138	57.74	239	99.98
Flakes	27	7.06	21	5.45	141	36.91	28	7.33	110	28.79	55	14.39	382	99.93
Utilized flakes	11	13.41	2	2.44	36	43.90	16	19.51	17	20.73	0	0	82	99.99
Tools	2	33.3	0	0	2	33.3	0	0	2	33.3	0	0	6	99.99
Cores	12	36.36	2	6.06	8	24.24	2	6.06	3	9.09	6	18.18	33	99.99
Hammerstones	5	27.77	2	11.11	6	33.33	3	16.66	2	11.11	0	0	18	99.98
Ground stone tools	6	16.21	3	8.10	18	48.64	8	21.62	2	5.40	0	0	37	99.97
Ground stone fire-cracked rock	35	12.11	8	2.76	135	46.71	69	23.87	42	14.53	0	0	289	99.98
Fire-cracked rock	70	12.65	5	0.90	284	51.35	123	22.24	71	12.83	0	0	553	99.97
Burned caliche	250	17.61	37	2.60	921	64.90	141	9.93	70	4.93	0	0	1,419	99.97
Undifferentiated brownware	24	5.85	63	15.36	165	40.24	12	2.92	146	35.60	0	0	410	99.97
El Paso Polychrome	5	5.15	30	30.92	12	12.37	2	2.06	48	49.48	0	0	97	99.98
Other ceramics	1	2.22	2	4.44	3	6.66	0	0	39	86.66	0	0	45	99.98

Cluster 3 contains seven members with medium artifact density, but high artifact diversity. Cluster 3 contains the next highest proportion of features, as well as high percentages of flakes, utilized flakes, tools, ground stone tools, ground stone fire-cracked rock, fire-cracked rock, burned caliche, and undifferentiated brownware sherds. Locations in this cluster may indicate areas utilized for processing activities or residential sites. The high percentage of brownware sherds may suggest temporal differences between these locations and others. The possibility also exists that the high number of sherds indicate food preparation activities, that is, residential bases.

Cluster 4 contains 12 members that have low artifact density and low artifact diversity. High percentages of debitage, utilized flakes, ground stone tools, and ground stone fire-cracked rock and low percentages of features and other artifact types mark Cluster 4 locations. This cluster also lacks any intrusive ceramic types. Locations in this cluster may also be similar to those in Clusters 1 and 2.

Cluster 5 contains two members that have high artifact densities and high artifact diversities. Few surface features, relatively high percentages of flakes, utilized flakes, tools, and ceramics, especially El Paso polychrome and intrusive types, mark the two locations in this cluster. Such locations may indicate temporal differences from other locations or residential sites.

Cluster 6 contains one member (41EP4716), a high density, low diversity site thought to be a single occupation representing the primary reduction of a limestone-chert core.

Discussion

Again, the interpretation of these clusters is similar to the results of the SVD analysis in that direct interpretation is challenging, yet encouraging. Geomorphological effects, long-term reuse of various locations throughout the Hueco Bolson, and activity of collectors for the past 100+ years make reconstructing actual location functions difficult. Certain locations, however, do appear to have been utilized for certain functions based on the presence of features with high percentages of fire-cracked rock and burned caliche, as well as features containing low percentages of these materials. The differential presence of certain ceramic types also suggests either temporal distinctions or differences in function. Cluster 3 with high incidences of ground stone tools may indicate processing activities that require nearby features. In general, the analysis defined two groups. The first group contains locations that have relatively low artifact density and diversity (Clusters 1 and 2 and to a lesser extent, Cluster 4). The second group contains locations that have relatively high artifact density and diversity (Clusters 3 and 5).

Camilli et al. (1988: 8-18–8-30) in a similar analysis of assemblage composition define two main assemblage groups, "additive" and "subtractive." Additive assemblages contain high density remains and high artifact diversity in frequently reused locations that may not have been subjected to long-term recycling. Subtractive assemblages contain low to high density remains, but have low overall artifact diversity indicating that these locations may have been targeted for extensive recycling of available materials, especially ground stone (Camilli et al. 1988: 8-30). The analysis of the Tobin Well surface assemblages shows a similar pattern of additive versus subtractive assemblages, but at a much weaker level.

Binford (1992), in her analysis of assemblage composition for artifact classes and activity groups, reveals five- and four-cluster solutions. These solutions are similar to those revealed in her SVD analysis with some differences. Specifically, artifact class data variation may not indicate variations in actual activities, but may point to seasonal or functional variability in the use of heat-related feature locations (Binford 1992: 161–162).

Summary

The Tobin Well mapping and surface collection phase resulted in the collection of 3,610 artifacts, including 125 isolated artifacts, and the discovery of 43 features. Results of an analysis of assemblage content are encouraging and indicate that fire-cracked rock is a conditioning variable within archaeological assemblages at Tobin Well. An analysis of the assemblage composition to determine similarities and differences between the sites discovered during survey were difficult to interpret as no outstanding pattern was readily apparent. However, the results of this analysis are similar to those of Camilli et al. (1988) in that the Tobin Well assemblages indicate recycling of certain materials and show differential use of certain locations.

From these general analyses, is it possible to define site types listed in Chapter

3? Given the limited analyses performed, concrete definition of sites is probably not possible. Analyses of the Tobin Well surface data do, however, suggest the function of some of these locations. Based on these analyses alone, both foraging and logistical locations are probably represented by some of the defined sites. Traveling camps may also be represented. Residential bases are harder to define by surface evidence alone, although hints are there and the subsurface testing data analyses in Chapter 8 may shed light on these locations.

6
CERAMICS

by

Chris Lowry and Mark Bentley

Project 91-14 used various methods to maximize data recovery for the survey and testing phase. The first part of this chapter explains the methods and procedures used for the formal study of ceramics and the results of the general ceramic analyses. Information presented in this section is primarily descriptive and examines only general patterns in the Tobin Well ceramic assemblage. Patterns are divided into project level, type level, and temporal level. The second part presents the results of instrumental neutron activation analysis to match clay source locations with prehistoric sherds. This analysis attempted to identify possible production locales used by the past inhabitants of the region and provide baseline data for ceramic production and distribution studies.

Methods

Project personnel documented ceramics from both surface and subsurface contexts, recorded all pertinent information from the artifact bags, and analyzed each sherd, recording the following information:

- Vessel part (body, neck, shoulder, base, rim)
- Vessel form (bowl or jar)
- Dimensions (length, width, thickness. Length generally is the longest axis, except when the orientation of the sherd is definitely known. Width is usually the opposite of the length measurement. Thickness is measured on the thickest part of the sherd.)
- Temper type (fine, medium, coarse)
- Paste color (black, brown, red-brown, others)
- Surface finish (generally smooth, some corrugated wares)
- Decoration (paint or type of decoration, for example, stripes, bands)

Finally, any other important aspects of the sherd in question were noted. Some sherds were deemed too small for effective measurement (generally fewer than 15 millimeters). All bag information and some variable information was recorded for these sherds, but measurements were not made.

Analyses

Project 91-14 used several methods in the analysis of ceramic data to maximize the amount of information obtained. The first explored project level patterns, followed by type level patterns and temporal level patterns. Project level patterns are general in nature and utilize the entire database of ceramic materials to arrive at generalizations concerning ceramic form, composition, and function. Type and temporal level patterns focus on the individual ceramic types used throughout the region. Since the chronology of the ceramic types are known, these patterns also indicate temporal change. The purpose of this is to help define patterns within the specific types of ceramics and document any change over time that may have occurred within and between the types of ceramics. Though not all data may be relevant to this report, the information is included for investigators interested in such patterns.

Project Level Patterns

Project personnel analyzed 1,181 ceramic sherds. Nearly 74% of the assemblage is undifferentiated brownware, while 1.6% can definitely be classified as El Paso Brown because of the presence of rim sherds. El Paso Bichrome and El Paso Polychrome make up another 15.9% (Table 6.1). Thus, more than 91% of the ceramics are El Paso wares. The other 9% are regarded as intrusive wares. The most common intrusive wares are Playas redwares, which may also be locally manufactured, followed by unknown plain wares and Chupadero Black-on-white. The El Paso Bichrome category includes all locally made sherds that have red or black pigment applied to the brown surface. Due to the fragmentary condition of many of the sherds, some of the El Paso Bichrome pottery may be fragments of El Paso Polychrome vessels. Additionally, after weathering, these sherds may retain only remnant evidence of their original decorative pigments. For example, El Paso Polychrome often contains a fugitive red paint that is less durable than the black pigment applied to the same vessel. Subsequently, weathered El Paso Polychrome sherds may, through remnant evidence, fall into the classification of El Paso Bichrome. Further, the undifferentiated brownware category may contain fragments from bichrome or polychrome vessels, complicating classification of sherds even more. This is due to the fact that some bichrome and polychrome vessels were painted on only the top half (Runyan and Hedrick 1973).

Table 6.1 Tobin Well Ceramics.

Type	Surface	Subsurface	Total
Undifferentiated brownware	392	476	868
El Paso Bichrome	65	35	100
El Paso Polychrome	32	56	88
Playas Red	14	42	56
Unknown Plain	10	18	28
El Paso Brown	17	2	19
Chupadero Black-on-white	12	1	13
Mimbres Classic Black-on-white	4	0	4
Mimbres Transitional Black-on-white	1	0	1
Other Mimbres	1	0	1
Three Rivers Red on terra cotta	1	0	1
Unknown Textured	1	0	1
Unknown Painted	0	1	1
Total	550	631	1,181

Nearly 69% of the ceramics are from nonfeature contexts. All other ceramics are from feature-related contexts with nearly

19% from Feature 25, a midden on site 41EP4719.

Fifty-nine percent of the project assemblage has black paste and 36.9% has brown paste, which reflects differences in the intensity and duration of the firing of the clay's organic material in these vessels (Rice 1987; Sinopoli 1991). The larger the vessels are, the more difficult it is to sustain high and sufficient temperatures to burn out the organic material mixed with the clay. Thus, the more complete the firing process, the less the gray to black paste color will be present (Bentley 1992b).

Of related interest is the high percentage (77.9%) of coarse-grained temper, which may indicate a preference for certain temper sizes for particular vessel forms. Coarse-grained tempers are generally more useful for water storage vessels, cooking pots, and larger sized vessel forms because of the temper's ability to increase porosity and resistance to thermal expansion (Rice 1987).

Not surprisingly, 73.9% of the sherds recovered are body sherds. The unknown category contains 19.9%, and rim sherds make up 4.4% of the total ceramic sample. The remainder (1.9%) of the vessel parts include a few neck, base, and shoulder pieces.

Vessel forms recorded for Tobin Well ceramics are 42.5% jars, 23.2% bowls, and 34.2% unknown. Vessel form was determined by examining the general shape of the sherd and by the amount of interior smoothing present. In general, jars have little interior smoothing, whereas bowls exhibit more interior smoothing.

Smoothing, which makes up 85.7% of the total ceramic sample, dominates surface treatments for vessels; rough surface treatment makes up 11.4% of the sample. Rough surfaces may be the result of weathering and breakage and not the actual prehistoric treatment of vessels. Surface treatment also may be related to vessel function, that is, rough surfaces are more useful for cooking vessels because they increase handling ability as well as thermal properties (Rice 1987; Schiffer et al. 1994). The remainder of the surface treatments—polished, slipped, corrugated, incised, and unknown—make up the balance (2.5%) and are found primarily on intrusive sherds such as Mimbres and Chihuahuan wares.

Type and Temporal Level Patterns

Sorting project-level El Paso brownware sherds by type revealed some interesting patterns (Table 6.2). Barring sample size biases, these data appear to indicate an increase of mean sherd size by type. Factors that influence this trend may be related to the length of time that sherds have been in the ground or exposed on the surface—more recently deposited sherds most likely will not be broken up as much. What does this trend mean? This characteristic probably reveals less about cultural change than about the nature of site deposition and exposure.

Table 6.2 Ceramic Dimensions.

Type	Number	Mean Length (mm)	Mean Width (mm)	Mean Thickness (mm)
Undifferentiated brownware	779	23	17	5
El Paso Brown	19	24	21	6
El Paso Bichrome	98	27	21	5
El Paso Polychrome	85	30	23	5

Both length and width measurements have high standard deviations (9.0–18.2), which indicate that considerable outside variability (weathering, trampling, sherd composition) is affecting these data. The large difference in sample size between undifferentiated brownware and El Paso Brown most likely affects the statistics within these two groups. The same holds true for El Paso Brown versus the painted wares.

Sherd thickness does not appear to be affected as much by outside factors. The standard deviations for these measurements are relatively low (circa 1.4–1.7) In fact, this measurement appears to indicate a decrease in mean sherd thickness through time. In general, vessel wall thickness is related to the size of the pot; larger vessels need thicker walls for structural support. Storage vessels may have thicker walls for increased stability or to retard moisture formation. Thick walls are also useful in resisting breakage during pounding, stirring, or mixing (Braun 1983; Rice 1983: 227; Reid 1989). In contrast, cooking wares generally have thinner walls because of improved heat conduction, which cooks food faster and saves fuel. Thin walls also benefit from improved thermal shock resistance (Rice 1987: 227).

Examination of paste by sherd type shows more black paste than brown paste. Undifferentiated brownware sherds comprise 60.0% black paste, 37.9% brown paste, and 1.9% other pastes. El Paso Bichrome sherds comprise 70.1% black paste, 28.9% brown paste, and 1.0% other paste. El Paso Polychrome sherds comprise 72.1% black paste, 26.7% brown paste, and 1.2% other paste. These data indicate differences in firing temperature and atmosphere that affected the paste color. Dark colored cores (pastes) usually indicate incomplete oxidizing atmosphere due to low temperature firings for short periods. The dark core indicates the presence of organic materials within the clay matrix that did not burn out upon firing (Rice 1987: 88). Organic materials usually burn out at 850 degrees Centigrade. A red to brown core indicates the presence of iron-bearing compounds within the clay and may also signal that these vessel firing temperatures were not more than 300 degrees Centigrade (Rice 1987; Sinopoli 1991). This pattern probably indicates changes in firing techniques or increasing logistical problems associated with firing more and larger vessel forms. The decrease in brown paste may indicate improved firing techniques in later periods. The increase in black paste probably points to the firing of more and larger vessels for storage and/or trade. Further, this change occurred gradually over time. The El Paso phase is regarded as a period of increased population and reliance on agriculture and changes in firing techniques brought on by increasing need for ceramic vessels for storage and exchange is not beyond the realm of possibility.

Temper types for undifferentiated brownware sherds are overwhelmingly coarse grained with 84.1% of the sherds containing this temper type. Medium-grained temper makes up 14.4%, and 1.5% is fine grained. El Paso Bichrome sherds contain 71.1% coarse-grained temper and 28.9% medium-grained temper. El Paso Polychrome sherds are 89.5% coarse-grained temper, 8.1% medium temper, and 2.3% fine temper. These data appear to show a preference for coarse-grained temper and a decreasing preference for the medium-grained temper. The use of fine temper appears to increase slightly through

time; however, sample size may have an effect on these data. The increase through time of coarser temper may indicate a change in overall ceramic production between the Formative and Pueblo periods. Coarse temper is usually added to improve the thermal expansion of clays (Rice 1987). Such additions are especially useful for cooking vessels (Braun 1983). Thus, if populations in later time periods used more cultivated plants, cooking wares likely increased in importance.

Vessel part data indicate an increase in the use of jars through time. More rim sherds are documented for El Paso Bichrome and Polychrome types than for undifferentiated brownwares. Undifferentiated brownware rims account for 2.4% of the total vessel parts, El Paso Bichrome rims are 9.3%, and El Paso Polychrome rims are 10.5%. Body sherds for all types appear to show no pattern through time. These data seem to indicate an increase in the number of vessels during the Pueblo period. Though ethnographic data show that hunter-gatherer groups used pottery, the number of vessels used by a group is not large (Reid 1989). Thus, an increase in the number of total vessels points to a change in mobility, possibly associated with increasing sedentism and cultivation.

Vessel form shows some interesting trends by type. Indigenous brownware sherds comprise 21.9% bowls, 39.2% jars, and 38.9% unknowns. El Paso Bichrome sherds comprise 29.9% bowls, 51.5% jars, and 18.6% unknowns. El Paso Polychrome sherds are 22.1% bowls, 60.5% jars, and 17.4% unknowns. Thus, these data show an increasing use of jars and a fluctuating use of bowls. Again, sample size may affect these patterns. Formative period jar forms were probably utilized as cooking ware rather than for storage. With increasing sedentism and cultivation during the Pueblo period, more jar forms probably reflect increasing demands for storage vessels and cooking pots.

Finally, surface treatment of sherds by type overwhelmingly shows scraping and smoothing as the preferred surface treatments. Only 14.4% of the indigenous brownware sherds show evidence of a rough surface, but this may be an effect of erosion on the older sherds. Smoothing the surface of a clay vessel reduces permeability; however, texturing (for example, corrugation) improves the grip. Rough surfaces also improve the absorption of heat through the vessel walls (Rice 1987: 232; Schiffer et al 1994). It is surprising that El Paso wares do not exhibit more rough surface treatment. Western Mogollon ceramic vessels (for example, Alma Plain) exhibit significant corrugated surface treatment, possibly indicating that certain types were used as cooking vessels. The virtual absence of rough surface treatments for El Paso wares is unusual and is in need further study.

Discussion

The results of these general analyses indicate that a change occurred in ceramic production in later Formative times. Data on paste color, temper type, vessel part, and vessel form all appear to support this hypothesis. Decreasing vessel wall thickness in later time periods is puzzling. One would expect increasing vessel wall thickness in later time periods if larger vessels were produced for food or water storage. Problems with the data may be related to small sample size or variability in wall thickness within a single vessel. Changes in paste color may

also point to improved ceramic technology in later time periods. Possible reasons for this change include a change in mobility and increasing reliance on cultivation (Scarborough 1992). Increasing production of ceramics for exchange may also be a factor.

Seaman and Mills (1988), in their analysis of the Borderstar 85 El Paso brownwares, note two important patterns. First, larger vessels appear to have been used in greater numbers in late Formative times. They state that this pattern may indicate more permanent storage facilities, but that it does not mean that late Formative peoples were more sedentary (Seaman and Mills 1988: 183). Second, they note that vessel shape appears to change and that this change may have functional importance. Neckless containers were more prevalent in early to middle Formative times, while necked vessels became increasingly important in late Formative times. Functionally, this may indicate an increase in the importance of contents, thus indicating more use of ceramics for storage and/or transport. The necked vessels may also have been more useful for increased cooking times (for example, stone boiling or boiling of starchy foods) and may signal a change in subsistence needs and diet (Seaman and Mills 1988: 183). Further, in their analysis of the Borderstar 85 and GBFEL-TIE ceramic assemblage, Seaman and Mills (1988) and Mills (1991) note high jar to bowl ratios. They suggest that because of the lack of permanent features, this high ratio would not be unusual.

Compositional Analyses

To further examine the nature of ceramic production and exchange within the region, the Tobin Well Project conducted compositional analyses on a sample of sherds collected during the project. Since the late 1950s, researchers in many parts of the world have identified archaeological ceramic materials through compositional analyses. Various techniques have had varying degrees of success (Perlman and Asaro 1969; Harbottle 1976; Wilson 1978; Bishop et al. 1982; Harris 1982; Peisachi et al. 1982; Rice and Saffer 1982; MacKenzie et al. 1983; Mommsen 1988; Topping and Mackenzie 1988; Williams and Wall 1991) Among the more popular are mineralogical identifications by X-ray diffraction (XRD) and elemental compositions by X-ray fluorescence spectroscopy (XRF). Other analyses include acid extraction in conjunction with inductively coupled plasma emission spectroscopy (ICP) and instrumental neutron activation analysis (INAA). Since the initiation of the Fort Bliss cultural resource management program in the late 1970s, various archaeological projects have applied all four compositional identification methods to prehistoric pottery. The section outlines the use and results of each procedure used at Fort Bliss, a detailed discussion of the research perspectives, and the results of the current INAA investigation for the Tobin Well Project (91-14).

X-Ray Diffraction (XRD)

During archaeological investigations conducted at McGregor range in 1977, researchers from the University of Texas at Austin employed X-ray diffraction coupled with petrographic and temperature characteristics to identify the mineral composition of

El Paso brownwares (Dulaney and Pigott 1977). They conclude that most brownwares are of temporally undefined local origin and that igneous-derived soils mixed with high levels of organic materials were used regularly. They observe that limestone-derived soils appear to have been avoided. Their conclusions about the abundance of igneous-derived minerals compared to limestone-derived ones are: (1) either brownware was made mainly in the western Tularosa Basin where there is an abundance of igneous minerals, or (2) the prehistoric potters avoided limestone-derived minerals and exclusively used igneous minerals wherever they were (Dulaney and Pigott 1977).

This early study comprises the building blocks that reformulated the studies of clay and ceramics in the region today. The mineral composition study was on track, but since then refinements through other techniques have been employed and regional prehistoric clays with igneous origins have been identified. For example, a study of clays and affiliated clay sources used in the production of El Paso Polychrome at Hot Well Village—as well as ceramic sherds from the site—traced the raw materials to clay outcrops in the Hueco Formation of the Hueco Mountains (Bentley 1995b). Igneous-derived soils constitute the majority of the clay used in the manufacture of aboriginal brownwares in the eastern Hueco Bolson and eastern half of the southern Tularosa Basin. XRD research identifies the origin of igneous-derived clays in the majority of McGregor Range and Maneuver Area II brownwares as the Hueco Mountains and local igneous sources, instead of the postulated prehistoric western bolson procurement by inhabitants on the opposite side of the desert floor. Bentley (1995b) reports these seyenite outcrops at Cerro Alto, Cathedral Mountain, and Hueco Tanks. These studies provide the geological baselines for both clay and temper through the mineral analysis of prehistorically prepared clays and ceramics.

X-Ray Fluorescence Spectroscopy (XRF)

During the Roving Sands-92 Project (92-02), Geo-Marine, Inc., researchers working on McGregor Range conducted elemental compositional research through X-ray fluorescence spectroscopy coupled with temperature characteristics of clay analyses (Bentley 1992b). An array of El Paso Brown, El Paso Bichrome, and El Paso Polychrome pottery was studied. The study also included geologically diverse clay source samples from the Hueco Bolson, southern Tularosa Basin, and adjacent mountains, as well as prehistorically prepared clay samples from Hot Well Village (41EP5) immediately south of McGregor Range. The sherds were examined to establish baseline compositional data for prehistoric source locales, prehistorically prepared clays, and pottery. Sample groups were statistically derived from the data set that originated from both geological and archaeological contexts. Trace element variances identified clay source affiliations with prehistoric pottery. This preliminary work demonstrated no affiliation between desert floor playa sources and prehistoric pottery and, also, first identified the Hueco Mountains igneous intrusions in the formation of the clays predominantly used in the southern part of McGregor Range and in Maneuver Area 2.

At the time of the study, XRF was as an excellent test for the major elements but it ascribed precise analyses to only a relatively small number of trace elements. A

seven-element suite produced qualitatively useful results, though the presence of sulfides weathered from the seyentic temper common in sherds from this side of the desert floor may have influenced the concentrations of lead (the second most common element in the analysis). Therefore, although this work is not conclusive, it presents good elemental correlations with the archaeological materials in the data set. Until now the usefulness of using the XRF technology has been tentative unless thoroughly demonstrated through either ICP or INAA. The significance of this may change as the newest XRF instrumentation holds promise of analyzing a larger suite of major, minor, and trace elements.

Inductively Coupled Plasma Emission Spectroscopy (ICP)

During the Hueco Mountain Project (91-07), archaeologists working at Fort Bliss conducted elemental compositional research through ICP on materials recovered through testing in Maneuver Area II (Burgett 1994b). Inductively-coupled plasma emission spectroscopy has advantages over XRD, XRF, and INAA. Foremost, it can process a more diverse set of major, minor, and trace elements in less time than INAA, although precision depends on the sample's concentration in the analyte solutions. However, its principal drawback is that it inherently contains poor sensitivity and spectral interferences to the trace elements lead, niobium, rubidium, tantalum, and thorium, along with the rare earth elements such as cesium, europium, lanthanum, lutecium, neodymium, samarium, terbium, yttrium, and ytterbium. Principal component factor and discriminant function analyses have found that many of these elements in the southern Jornada Mogollon region, particularly the rare earth elements are major components in the identification of prehistorically prepared clays and pottery affiliated with geological source locales through both XRF and INAA (Bentley, 1995b).

The Hueco Mountain Project (91-07) submitted a set of eleven El Paso Bichrome, ten El Paso Polychrome, seven Mimbres, ten Chupadero Black-on-white, and ten Ramos Polychrome sherds for ICP analysis. The suite used twelve elements. Through this study,

> A robust compositional similarity between the samples of stylistically different pottery types was determined, as Ramos Polychrome was found to be closely affiliated with the El Paso Bichrome and Polychrome wares, and part of the Mimbres sherd set was closely affiliated with Chupadero sherds (Burgett 1994b).

Previous analyses conducted through XRF produced initial robust correlations between both indigenous and intrusive pottery that were later confirmed or dismissed through additional testing of two-and three-way split samples, samples from prehistorically used goss (eroded parent rock) deposits, and clay sources, all of which were identified through INAA. Correlations through XRF have been cross-checked with INAA and additional verification of initial results has been made. Samples of sherds, clays, and tempers submitted through both XRF and INAA produced complementary results, verifying that some intrusive Playas redwares are not intrusive at all, but are instead local El Paso wares with textured decoration. These textured redwares are made of local clays and tempers and are identical to indigenous brownwares, prehis-

torically prepared clays, and clay outcrops. They are not identified as nearby groups, but rather cluster within the same groups as El Paso Polychrome. Aside from their surface decoration, they are identical to the polychrome wares in paste and temper.

At times, in a 7-or 12-element suite derived through either XRF or ICP, fewer than a handful of the principal components contribute to the 90-plus percentile range of variance within a data set. This limited number of elements causes the groups to cluster and, if the principal components are questionable, unsound results may result. For example, the ICP study seems to correlate Ramos Polychrome and El Paso brownwares through either one or a very small number of elements in the 12-element suite, producing closely affiliated groups of local brownwares and the intrusive pottery. Perhaps more elements are needed in this type of analysis in order to fine tune such a hypothesis. Also, identification of clay sources used in the manufacturing locales for Ramos Polychrome in northern Mexico needs study. Comparison with the eastern Hueco Bolson local brownwares may show that (1) the clays used in both the Ramos and El Paso wares are predominantly from igneous intrusions in the southwestern Chihuahuan desert, and (2) the inherent similarities between the pottery types have not been significantly demonstrated because too few elements control the correlations. When a significant set of nonmobile elements is used, different conclusions may be drawn.

Instrumental Neutron Activation Analysis (INAA)

Instrumental neutron activation analysis was first used in geological research in the 1930s. It was not until the late 1950s that researchers applied this method to trace element analyses of archaeological materials (Gordon et al. 1968; Perlman and Asaro 1969). INAA is best suited for precise analyses of trace elements including rare earths and transition metals. It is suitable for determining some, but not the all, the major elements.

Locally, the Tobin Well Project selected INAA for a set of source clays and affiliated fired pottery to provide initial baseline data about production and distribution of locally manufactured El Paso wares through elemental composition analysis. Local clay outcrops near the project area, prehistorically prepared clays found at three local pueblo villages, and sherds from the Tobin Well project area and other locations were submitted for analysis and are discussed later.

Regional compositional studies involving both XRF and INAA research used select major and minor elements and a larger array of rare earth elements (Bentley 1995b) to form the diversified log-normally distributed elemental suites. Dr. Michael D. Glascock of the Missouri University Research Reactor sums up a similar perspective:

> It is the trace constituents—elements at concentrations below 1,000 ppm—whose presence in clays is effectively "accidental" that provide the primary basis for provenience analysis. It is reasonable to anticipate that a more complete analysis, especially one which determines the trace element constituents, will increase the likelihood of success when utilizing chemical characterization for source determination. As a result, a highly sensitive analytical technique like neutron activation analy-

sis (NAA), which yields a simultaneous analysis on a large number of the elements at both major and trace concentrations, is often employed (Glascock 1992: 11).

Of all the elements available in compositional studies, the rare earth elements as a group, along with a select array of major and minor elements, are best suited for the study of clay and pottery. Neither XRF or ICP are capable of analyzing the large number of rare earth elements that INAA can. Thus, care should be exercised when utilizing such techniques. As with all types of chemical analyses, one should not rely solely upon their results to make interpretations. Other methods such as petrographic analysis should be used in conjunction with chemical techniques to refine hypotheses and test new assumptions (Arnold 1992; Bishop 1992).

Tobin Well INAA Studies

Database

Dr. Philip R. Kyle of the Socorro Bureau of Mines and the New Mexico Technical Institute performed instrumental neutron activation analysis on 53 samples from the Tobin Well Project. An attempt was made to include a wide spectrum of relevant samples. The collection of 10 clay sources near the project area established geological baselines to see if any of the project pottery grouped toward the sampled sources.

Local clay samples (Table 6.3) were collected from between 0.5 and 1.5 meters into the deposits to reduce the risk of contamination. The study did not sample some possibly prime clay source locations upslope from the project area because of potential soil contamination or because street and building construction covers them. Clay source locations were selected for accessibility, least likelihood of contamination, and range of potential geologic variability to correlate with the prehistoric pottery. Two sample locales are from the Franklin Mountains, four are from the alluvial fan of the Franklins, and four are from the transition zone where the alluvial fan and desert floor interface (Figure 6.1).

Table 6.3. Clay Sample Locations.

Sample #	Source	Zone	Color
TW-1	Anthony's Nose east (a)	Alluvial fan	Red
TW-2	Anthony's Nose west (b)	Alluvial fan	Gray
TW-3	Sherman Lake northeast	Transition	Tan
TW-4	50 m west of Sgt. Doyle Pueblo	Transition	Tan
TW-5	200 m southwest of Sgt. Doyle Pueblo	Transition	Tan
TW-6	South of Sugarloaf crest	Mountain	Yellow
TW-7	Hamilton St., west end	Alluvial fan	Pink/tan
TW-8	Radford St. , north end	Transition	Pink/tan
TW-9	West Fusselman crest	Mountain	Yellow
TW-10	Anthony's Nose, southeast	Alluvial fan	Red

Samples submitted for analyses comprised 23 whole sherds, 14 clay splits from sherds, 10 clay source locale samples, and 6 prehistorically prepared clays (Table 6.4). This multiple-sample approach produced information that would not have been observed if only whole sherds constituted the data set. One of the submitted sherds is Chupadero Black-on-white, 13 are El Paso Polychrome, 7 are undifferentiated brown-

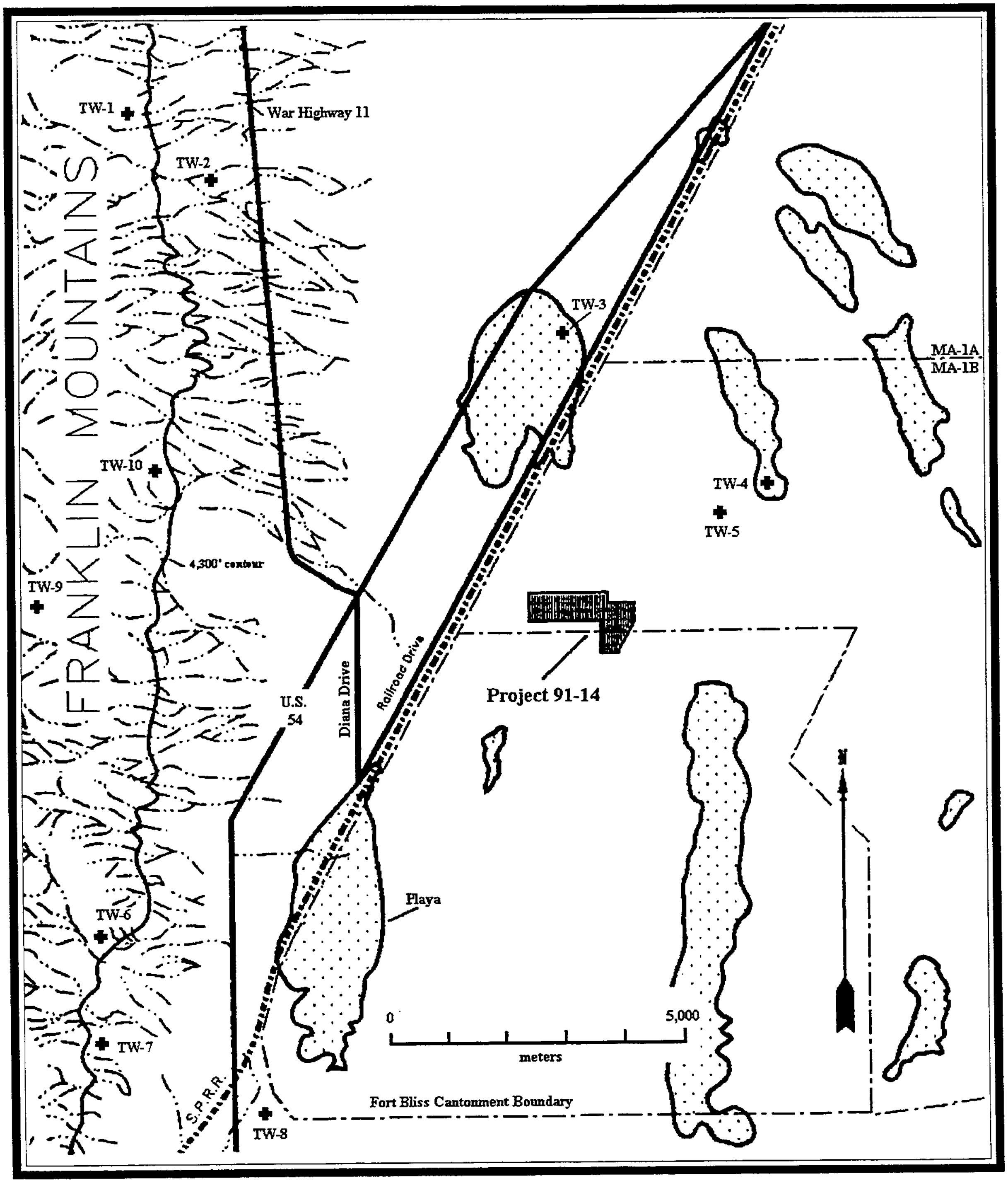

Figure 6.1. Clay Sources for INAA Study.

Table 6.4. INAA Samples.

Sample #	Discriminant Group #	Type	Location	Comments
TW-1	1	Clay	Locale #1	
TW-2	2	Clay	Locale #2	
TW-3	2	Clay	Locale #3	
TW-4	3	Clay	Locale #4	
TW-5	Not analyzed	Clay	Locale #5	
TW-6	Not analyzed	Clay	Locale #6	
TW-7	3	Clay	Locale #7	
TW-8	3	Clay	Locale #8	
TW-9	3	Clay	Locale #9	
TW-10	3	Prehistoric clay	Sgt. Doyle Pueblo	Feat. 21
TW-11	3	Chupadero Black-on-white	Sgt. Doyle Pueblo	Feat. 21
TW-12	1	Clay	Locale #10	
TW-13	3	Prehistoric clay	Pipeline Pueblo	Room 4, Feat. 4
TW-14	3	Prehistoric clay	Hot Well Pueblo	Room 1, Feat. 11
TW-15	3	Prehistoric clay	Hot Well Pueblo	Room 2, floor
TW-16	1	Prehistoric clay	Hot Well Pueblo	Kaolin clay, Room 2, Feat. 12
TW-17	1	El Paso Polychrome	Sgt. Doyle Pueblo	Whole sherd,Room 1, Feat. 2
TW-18	1	El Paso Polychrome	Sgt. Doyle Pueblo	Clay split
TW-19	1	El Paso Polychrome	Sgt. Doyle Pueblo	Whole sherd, Room 4, Feat. 9
TW-20	1	El Paso Polychrome	Sgt. Doyle Pueblo	Clay split
TW-21	1	El Paso Polychrome	Sgt. Doyle Pueblo	Whole sherd, Room 4, Feat. 9
TW-22	1	El Paso Polychrome	Sgt. Doyle Pueblo	Clay split
TW-23	1	El Paso Polychrome	Sgt Doyle Pueblo	Whole sherd, Room 9, Feat.1
TW-24	1	El Paso Polychrome	Sgt. Doyle Pueblo	Whole sherd, Room 9, Feat. 1
TW-25	1	Undifferentiated brownware	FB12429	Whole sherd, Feat. 28
TW-26	1	Undifferentiated brownware	FB12429	Clay split
TW-27	1	El Paso Polychrome	FB12429	Whole sherd, Feat. 26
TW-28	Not analyzed	El Paso Polychrome	FB12429	Clay split
TW-29	Not analyzed	El Paso Polychrome	FB12429	Whole sherd, Feat. 25
TW-30	1	El Paso Polychrome	FB12429	Clay Split
TW-31	1	El Paso Polychrome	FB12432	Whole sherd
TW-32	1	El Paso Polychrome	FB12432	Clay split

(Continued on next page.)

Table 6.4. INAA Samples (Continued).

Sample #	Discriminant Group #	Type	Location	Comments
TW-32	1	El Paso Polychrome	FB12432	Clay split
TW-33	1	El Paso Polychrome	FB12432	Whole sherd
TW-34	1	El Paso Polychrome	FB12432	Clay split
TW-35	Not analyzed	Undifferentiated brownware	FB12432	Whole sherd, Feat. 32
TW-36	1	Undifferentiated brownware	FB12432	Clay split
TW-37	1	Undifferentiated brownware	FB12441	Whole sherd, Feat. 37
TW-38	1	Undifferentiated brownware	FB12441	Clay split
TW-39	1	Undifferentiated brownware	FB12441	Whole sherd, Feat. 39
TW-40	1	Undifferentiated brownware	FB12441	Clay split
TW-41	1	Undifferentiated brownware	FB12441	Whole sherd, Feat. 39
TW-42	1	Undifferentiated brownware	FB12441	Clay split
TW-43	1	Undifferentiated brownware	FB12444	Whole sherd
TW-44	1	Undifferentiated brownware	FB12444	Whole sherd
TW-45	1	El Paso Polychrome	FB12444	Whole sherd
TW-46	1	El Paso Polychrome	FB12444	Clay split
TW-47	3	El Paso Polychrome	FB12445	Whole sherd
TW-48	1	El Paso Polychrome	FB12445	Whole sherd
TW-49	3	Historic brownware	Isolated find	Surface, Tobin Well
MB3-1	1	Prehistoric clay	Pipeline Pueblo	Clay and temper cache
MB3-2	1	El Paso Polychrome	Pipeline Pueblo	Whole sherd
MB3-3	1	El Paso Polychrome	Pipeline Pueblo	Clay split
MB3-4	3	Historic brownware	Agave Hill	Surface

wares, and 2 are early historic brownwares. The six clays of prehistoric origin were submitted to determine clay source locales used at particular sites. Ten clay sources were sampled near the Tobin Well project area to compare outcrop clays to sherds and prehistoric clays.

Sample Processing

Prehistoric brownware sherds were split into two samples; the first half contained the complete temper and paste content and the second split contained only the paste. The sherds were split by crushing a portion of the sherd with a hammer and carefully extracting the paste via window screen. The purpose of this exercise was to attempt to obtain a compositional signature from the paste along with a signature from the total sherd—its paste and temper composition. This was undertaken in the hopes of assessing the influence of the temper on paste composition for ceramics in this region. Previous researchers (Neff 1988, 1989; Elam et al.

1992) tested this assumption and concluded, "tempering with aplastics usually poses no serious threat to identifying archaeologically significant groups in a ceramic composition data set" (Elam 1992: 95). Fourteen were split samples; the first split contained the paste and temper, and the second contained only the paste. With this project, for example, Samples 29 (whole sherd) and 30 (paste) are in this category. Through previous and ongoing research with local brownware pottery, the degree of contamination from segregating the clay and tempering material in this split process has been nominal (Bentley 1992b). Tempering materials used at different prehistoric manufacturing locales often contain different trace elements because different clay and temper deposits were exploited. Local clays may also contain high amounts of aplastic (tempering) material of natural origin. Once compositional analyses identify these deposits, comparisons of the local outcrops and prehistoric sherds will hopefully allow identification of production locales and their relation to other locales in the greater cultural system.

Expectations

Expectations generated to evaluate the results of the compositional analysis include:

- Ceramics from the area in and around Tobin Well should be compositionally similar to one or more clay outcrops near the project area.
- Ceramic types (El Paso Brown and El Paso Polychrome) should exhibit differences in clay composition. Though analysis included no rim sherds from El Paso Brown, the researchers hoped that some of the undifferentiated brownware sherds might come from El Paso Brown vessels.
- Typologically distinct (intrusive) sherds should not exhibit compositional similarity to local clay sources or local brownware sherds.

To aid in evaluation of these expectations, the analysis included sherds from Pipeline Pueblo and Sergeant Doyle (41EP18) sites along with prehistorically prepared clays from Pipeline Pueblo and Hot Well Pueblo (41EP5). Inclusion of these extra sherds and clays added to an already small sample size and allowed examination of patterns between sites outside the project area.

Methods

All samples were submitted to the Socorro Bureau of Mines for preparation. These materials were ground into powder and weighed. Subsequently, each sample was encapsulated in a container holding 200 milligrams. Standards for calibration were included with the samples for shipment to the research reactor at Texas A&M University. At the reactor, low energy neutrons bombarded the samples for a controlled period of time. This bombardment altered the samples' compositional structures producing unstable elemental isotopes that decayed through the emission of radiation. Each element has its own rate of decay.

Gamma rays are the most important energy source for trace elemental determinations in INAA. These rays are measured through amplifiers and multichannel analyzers. After return shipment from the reactor to the Socorro Bureau of Mines, all samples were counted four times at different intervals. This stage identified trace

elements and calculated their concentrations. Within these sample sets, 24 elements were identified with their concentrations computed in parts per million, and at times, parts per billion. The accuracy in the data analyzed by the Socorro Bureau of Mines and presented within this study ranges from plus or minus 2 to as high as 5%, depending on the element. Two compounds Na_20 (sodium oxide) and FeO (iron oxide) were removed from the analysis as they are not elements and their proportions are measured in percentage weight rather than parts per million. This left a total of 22 elements for compositional analysis. Sample TW-46 also was excluded from the analysis because of insufficient size. Four other samples had missing values for one element but were utilized in the analysis when allowed. Appendix B presents the INAA analyses of materials submitted through the Tobin Well project and analyzed through INAA by the Socorro Bureau of Mines.

Because it is extremely difficult to isolate patterns through visual inspection of the element data, several statistical techniques were employed to analyze the compositional data obtained through INAA. Bishop et al. (1982) stress the importance of analyzing the actual variances in the log-normally transformed data between the discriminated groups and not the ratios of the grouped elements. Therefore, all raw data received from the lab were transformed to logarithmic values for statistical calculations and graphs. Statistical analyses performed in this study include bivariate plots of various elements, hierarchical cluster analysis to aid in identifying compositional groupings, principal components analysis to aid in the extraction of a reduced set of elements that are significant in defining compositional groupings, and canonical discriminant function analysis used in the categorical association of the samples to the compositional groups. All statistical analyses were conducted using Statistical Package for the Social Sciences software (Windows version 5.0.1).

Results

Analysis of the Tobin Well samples produced some interesting patterns within the data set. First, bivariate plots (Figs. 6.2–6.5) of various elements reveal two to three rough groups based on the analyzed elements. Two groups are apparent in all of the plots—one group comprises primarily El Paso brownware sherds with a small number clays, while the other group comprises only clay sources and prehistoric clays. Figure 6.3 shows three possible groupings—the two main groups and a third group comprising some sherds and clays. These data indicate that most of the clays subjected to analysis are not related to the tested sherds. Further, it appears that there may be two compositionally distinct groups of sherds.

Second, whole sherds were compared with their clay split counterparts using hierarchical cluster analysis (using Ward's method with squared Euclidean distances). Groupings between samples were evident; however, examination of the dendrogram (Figure 6.6) and comparison with Table 6.4 reveals that clay splits cluster closely with their sherd counterparts. Discriminant analysis of this data set confirmed this conclusion. One would expect the pure clay to group away from the whole sherd, but this was not the case. Reasons for this include the questionable method used to separate the clay from the temper and other inclusions, the possibility that temper within the clay

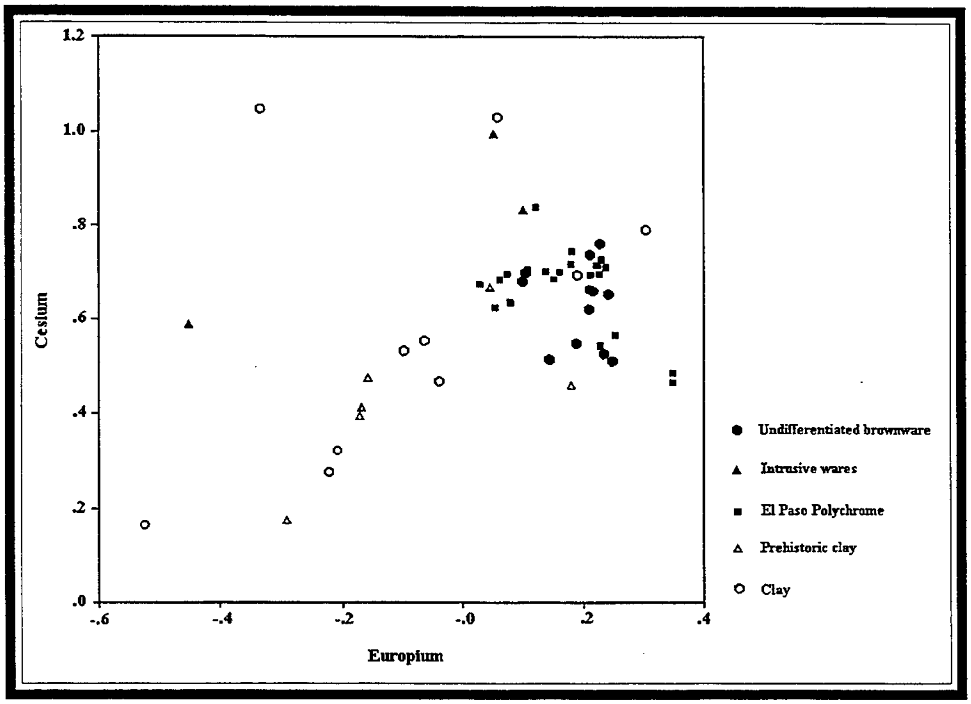

Figure 6.2. Logged Elements Europium and Cesium.

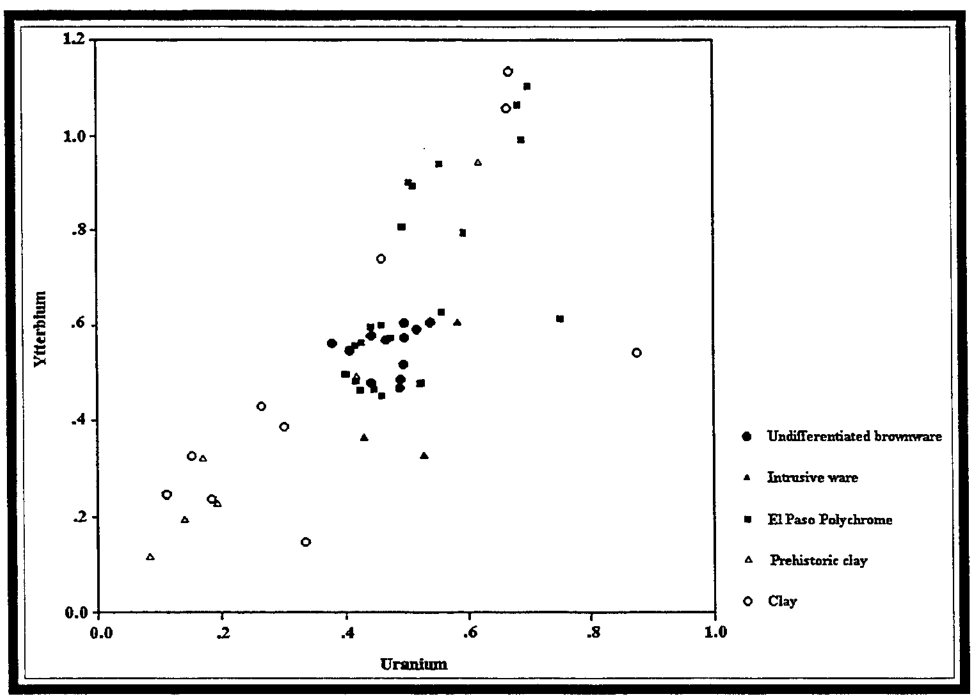

Figure 6.3. Logged Elements Uranium and Ytterbium.

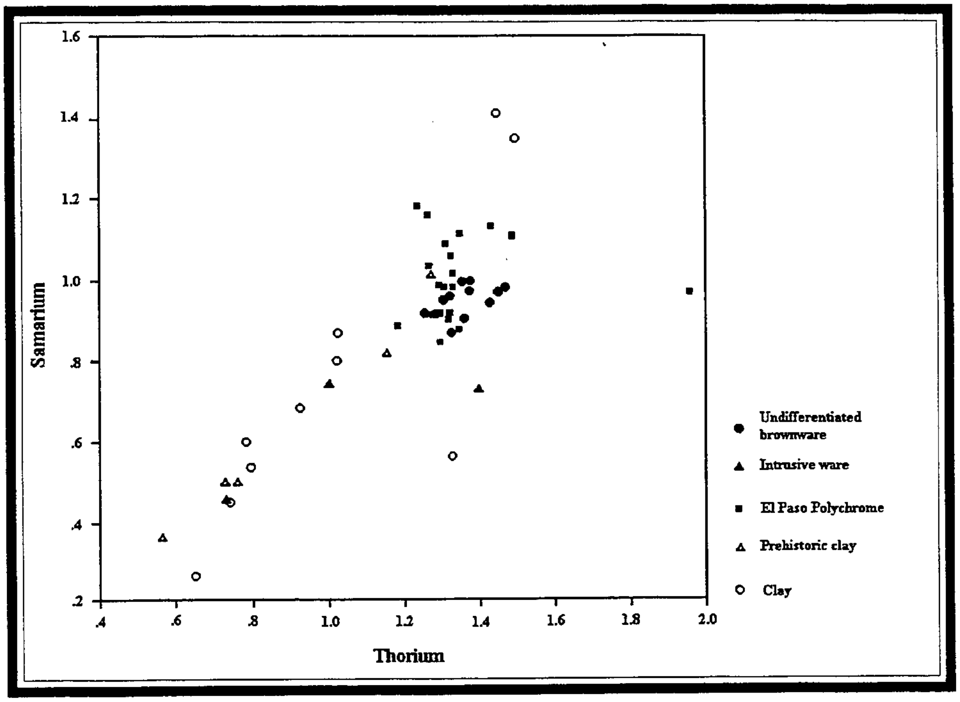

Figure 6.4. Logged Elements Thorium and Samarium.

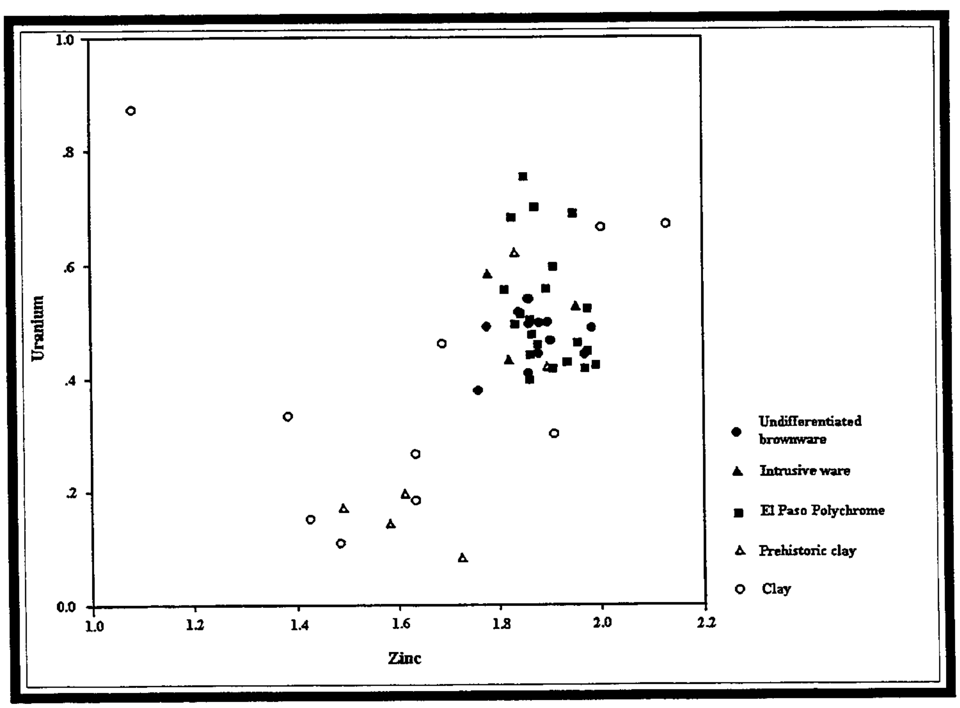

Figure 6.5. Logged Elements Zinc and Uranium.

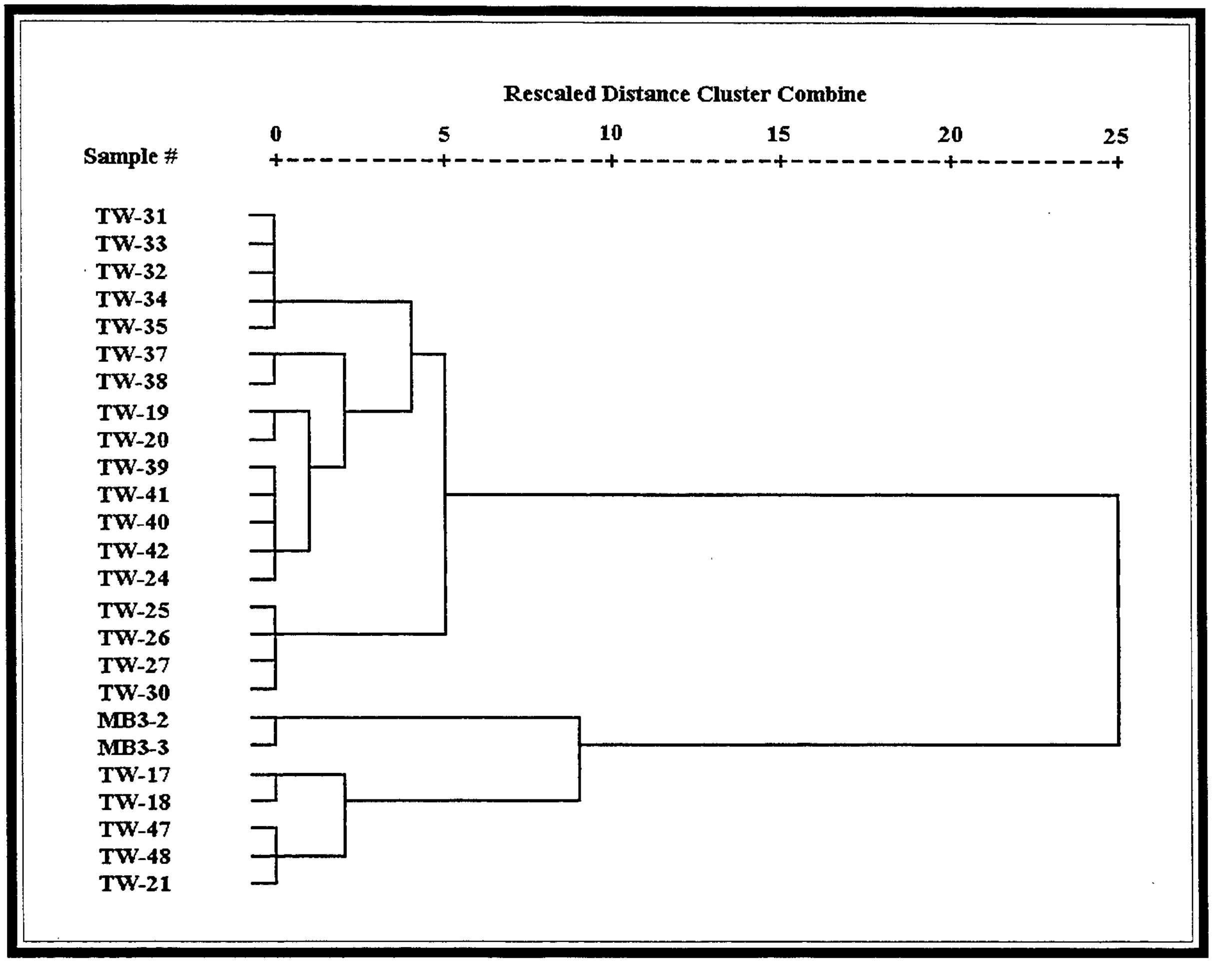

Figure 6.6. Whole Sherds and Clay Splits. The analysis used 25 cases; 3 cases were rejected due to missing values.

matrix was not sufficient to affect the chemical analysis results unduly or that the clays and temper are geologically similar (that is, derived from similar granitic sources). A comparison of sherds by type indicates no differences between the undifferentiated brownwares and El Paso Polychrome. Thus, compositionally, these clays and clays with temper appear similar.

Next, all sherds (including clay splits) were compared to the collected clays and prehistoric clays using hierarchical cluster analysis (Ward's method with squared Euclidean distances). Several groups were evident, and three main clusters were defined (Figure 6.7). Cluster 1 contained all the sherds and two prehistoric clays. Cluster 2 contained collected clays, intrusive sherds, and prehistoric clays. Cluster 3 contained two collected clays. To check the robustness of this pattern, principal components analysis was used to further analyze the data set (Table 6.5, 6.6, and Figure 6.8). This analysis clearly shows two groups (possibly three): one robust group of El Paso brownware sherds and a small number of clays, and a second, less well-defined group of clay

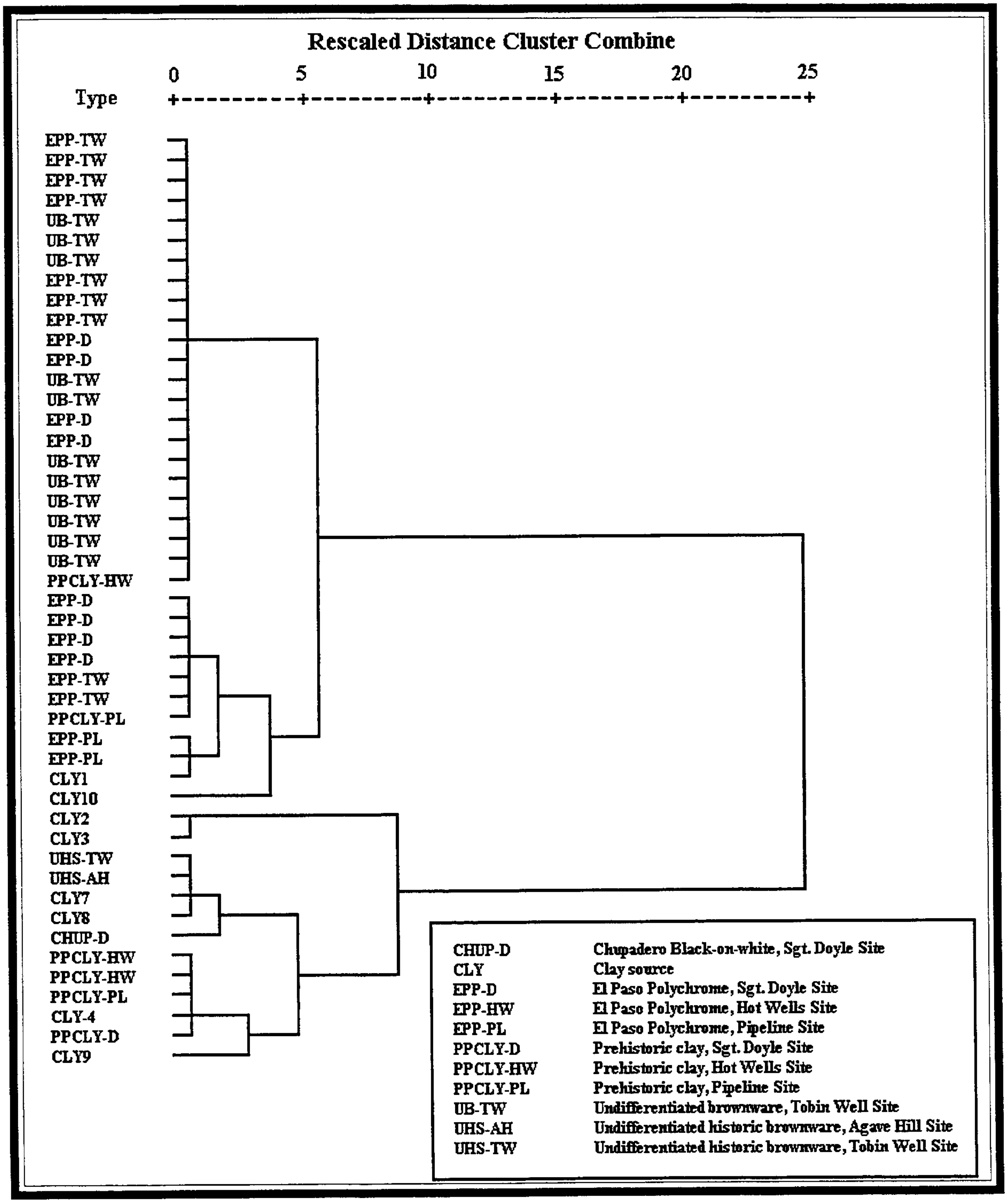

Figure 6.7. Sherds and Clays. The analysis used 47 cases; 5 cases were rejected due to missing values.

sources, prehistoric clays, and intrusive sherds. One could argue for a third group, a subgroup of the sherds that may indicate two compositionally distinct groups of sherds. To check this solution, a discriminant analysis was performed (Figure 6.9); the level of discrimination between the groups is quite good indicating a strong solution. Group descriptions are summarized below.

Table 6.5. Variance Explained by Principal Component.

Principal Component #	Eigenvalue	% of Variance Explained	Cumulative % of Variance
1	11.95355	54.3	54.3
2	2.94163	13.4	67.7
3	1.79027	8.1	75.8
4	1.17405	5.3	81.2
5	0.95482	4.3	85.5
6	0.83225	3.8	89.3
7	0.70782	3.2	92.5
8	0.51082	2.3	94.8
9	0.30010	1.4	96.2
10	0.22128	1.0	97.2
11	0.19653	0.9	98.1
12	0.11204	0.5	98.6
13	0.09011	0.4	99.0
14	0.06140	0.3	99.3
15	0.04326	0.2	99.5
16	0.03523	0.2	99.7
17	0.02796	0.1	99.8
18	0.02591	0.1	99.9
19	0.01078	0.0	100.0
20	0.00846	0.0	100.0
21	0.00102	0.0	100.0
22	0.00069	0.0	100.0

Table 6.6. Principal Component Loadings for Elements.

Element	Component 1	Component 2	Component 3	Component 4
Antimony	0.30804	0.72598	0.37327	-0.01710
Arsenic	0.50355	0.20752	0.56384	0.20619
Barium	0.41485	0.39596	-0.20983	0.56846
Bromine	0.33146	-0.06143	-0.09567	-0.49846
Cerium	0.94384	-0.14280	-0.16786	0.07965
Cesium	0.55298	0.48126	0.26674	-0.42521
Chromium	0.58711	0.59612	-0.11738	-0.08809
Cobalt	0.61602	0.60371	-0.25623	-0.32398
Europium	0.82757	0.16846	-0.37788	0.11793
Hafnium	0.75138	-0.50084	-0.03769	-0.03211
Lanthanum	0.92767	-0.06558	-0.24667	0.18438
Lutetium	0.80436	-0.47547	0.16911	-0.09931
Neodymium	0.92050	-0.20871	-0.06862	0.03416
Rubidium	0.05792	0.18533	0.60029	0.34532
Samarium	0.96386	-0.19581	-0.10558	0.03317
Scandium	0.84103	0.44671	0.03533	-0.11416
Tantalum	0.87302	-0.05714	0.06918	0.14980
Terbium	0.92208	-0.31437	0.05173	-0.05973
Thorium	0.86501	0.01797	0.20995	0.06216
Uranium	0.75146	-0.18296	0.48755	-0.08628
Ytterbium	0.81039	-0.46525	0.18108	-0.09889
Zinc	0.75911	0.24776	-0.40990	0.13904

Group 1 contains 38 members—all the local brownware sherds submitted for analysis. Two prehistoric clays are also part of this group—one from Hot Well Pueblo and the other from Pipeline Pueblo. The Hot Well and Pipeline clays are closely linked to sherds from Sergeant Doyle Pueblo and Tobin Well. One collected clay from Locale 1 also falls into this group and shows close affinity to sherds from Pipeline Pueblo and a

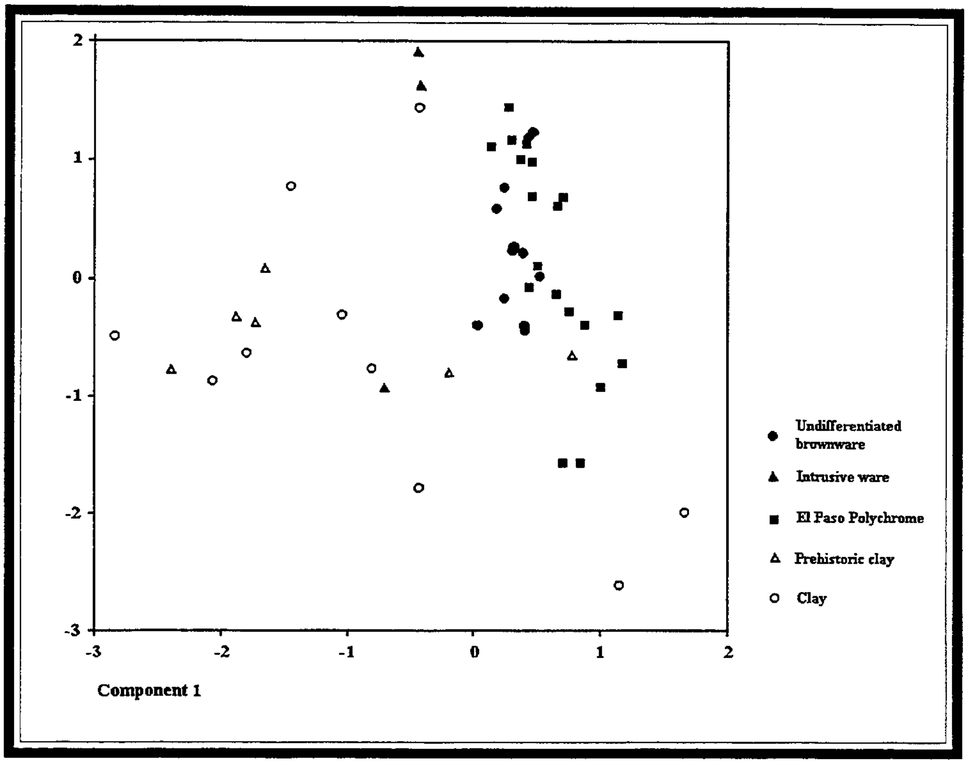

Figure 6.8. Principal Components Based on 22 Elements.

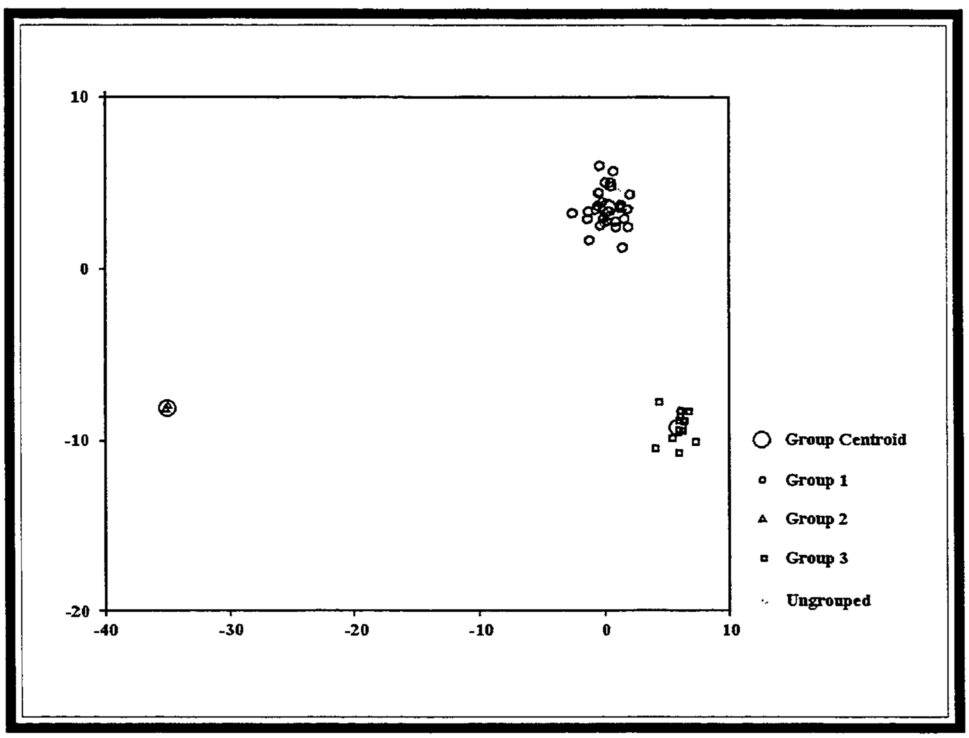

Figure 6.9. Canonical Discriminant Functions for Sherds and Clays.

weaker link to sherds from Sergeant Doyle Pueblo and Tobin Well. Another collected clay (Locale 10) falls into this group (although weakly) and is associated with sherds from Pipeline Pueblo, Sergeant Doyle Pueblo, and Tobin Well. The sherds and clays are strongly correlated indicating a high probability of correct discrimination (Figure 6.9).

Group 2 contains only two collected clays (Locales 2 and 3). No sherds are in this group.

Group 3, which contains 12 members, comprises most of the clays collected near the Tobin Well project area and some of the prehistorically prepared clays. The historic sherds group with clays collected from Locales 7 and 8 near Tobin Well. The single Chupadero Black-on-white sherd is also weakly linked to these sources. None of the other sherds in the analysis are in this group.

Discussion

In general, some interesting inferences may be made from INAA analyses of clay and pottery samples. First, is the identification of a potential compositional signature for El Paso brownwares within this region. Second, the results of this analysis indicate that temper (whether natural or added) does not appear to bias the chemical compositions reported for El Paso brownware sherds, despite the characteristic abundance of temper particles. Split clay samples are closely correlated to their sherd counterparts. This does not mean that future analyses should ignore the effects of temper. Previous researchers (Neff 1988, 1989; Arnold 1992; Elam et al. 1992) examine the relationship between temper and clay and conclude that while "aplastics, whether naturally present in the clay, or added by the potter, do not obfuscate formation of archaeologically meaningful groups" (Arnold 1992: 164), the context of clays and tempering material in relation to the variability of the overall geological landscape needs to be addressed.

Third, and most interesting, is the occurrence of all brownware sherds in a single group. Sherds from varying locations were expected to group to clay sources, either prehistoric or contemporary. Instead, few sherds correlated with clays located near Tobin Well. The most unusual aspect is the correlation of a Hot Well Pueblo prehistoric clay to sherds from Tobin Well and Sergeant Doyle Pueblo. Is this a case of regional exchange of pottery from different village core areas? The possibility certainly exists, although much more testing of clays near Hot Well Pueblo needs to be done before such an assertion can be made with confidence. A more likely reason is a failure to collect enough clays from the vicinity of Tobin Well. Fish et al. (1992), in their analysis of Tanque Verde Red-on-brown sherds from southern Arizona, encountered a similar problem with correlation of raw clay locales and prehistoric sherds. The authors feel that too few clay locations were sampled and that mixing of clay deposits has occurred since the construction of these vessels, altering the chemical composition of the clay outcrops (Fish et al. 1992: 250–251).

The analysis indicates a correlation between a clay near Tobin Well and sherds from Sergeant Doyle and Tobin Well. This may indicate that at least some of the pottery constructed in and around the project area was manufactured locally. The bivariate plots, cluster analysis, and the principal components indicate weak groupings between the sherds. One group is composed

primarily of sherds from Tobin Well with a few sherds from the Sergeant Doyle Pueblo, while the other group comprises primarily sherds from Sergeant Doyle Pueblo with a few sherds from Tobin Well. This weak relationship may be pointing to exchange of pottery between the two areas or the transport of pottery from one area to the other.

Fourth, comparisons of the sherds by type (undifferentiated brownware versus El Paso Polychrome) indicate no differences in clay composition. It was felt if some of the undifferentiated sherds came from the earlier El Paso Brown type, that these might be distinguished from the later El Paso Polychrome type. Instead, all the undifferentiated brownwares and El Paso polychromes appear compositionally similar, indicating either the brownware sherds are actually from polychrome vessels or that El Paso Brown was constructed using similar clay sources to that of El Paso Polychrome.

Finally, the link between the intrusive Chupadero sherd, the historic sherds, and two of the collected clays is puzzling. Though the link is weak, a case can be made for the local production of Chupadero Black-on-white. This seems unlikely, however, until more Chupadero sherds are subjected to analysis. The historic sherd-clay link is interesting in that similar pottery types have been found throughout the region. No firm data for this type exists other than it occurred when the Spanish lived in the area (circa 1680 to 1880). The possibility that these historic sherds were constructed from local clay materials is fairly strong and should not be discounted.

Conclusions

This preliminary INAA study in no way infers that it has solved the myriad compositional problems that could be addressed.. As some are solved, other questions and problems become apparent. The most important contribution of this study is the identification of a compositional signature for El Paso brownwares in this area. Such a signature will allow future researchers to compare similar compositional data from the different areas. Such comparisons may eventually lead to defining ceramic production areas and examining ceramic distribution patterns. Further, this analysis adds to a growing body of compositional data for the Jornada Mogollon region. As more sherd and clay samples from different areas and more types are subjected to compositional analysis, a greater understanding of prehistoric ceramic production and exchange will be realized.

Summary

Overall, 1,181 ceramic sherds were analyzed for the Tobin Well Project. At the project level most sherds are local El Paso wares. Black paste is more common than brown, and coarse temper is added to the clay more often than finer temper. Vessel parts are primarily body sherds and the most common vessel form is the jar. Surfaces generally are smoothed.

At the type and temporal levels, sherd size (length and width) appears to decrease by type with polychrome sherds being larger and brownware sherds being smaller; however, the data is highly variable. One possible explanation is the exposure of older sherds to more breakage, and hence, smaller recovered pieces. The dynamic nature of the bolson geomorphology may also be

responsible for such a pattern. Thickness data from this analysis showing vessel wall thickness decreasing in later time periods appears to contradict the expected pattern. This may indicate an increase in cooking or boiling vessels because thin-walled vessel are more heat conductive than those with thick-walls (Braun 1983; Rice 1987). A change in ceramic production technology may also be responsible for this unusual pattern. Black paste appears to increase in later time periods, while red-brown paste decreases, indicating a change in firing technology. Vessel part and form data indicate more rims for later ceramic types, which may indicate increased use and abundance of later El Paso painted wares or point to a possible shift in mobility.

Instrumental neutron activation analysis was conducted on 53 samples from the Tobin Well project. Sherds from Tobin Well, Pipeline Pueblo, and Sergeant Doyle Pueblo, along with prehistoric clays and local clay samples from the region, were used in the analysis. The results of the analysis indicate that few sherds correlate with either prehistoric or modern clays. Some clays and sherds, however, correlate, indicating the possibility that at least some of the ceramics in and near the project area were constructed locally. Whole sherds and clay splits were analyzed in the hopes of isolating clay and temper differences. Analysis indicates no difference between sherds with temper and clays only. The most important contribution of this analysis is the identification of a compositional signature for El Paso brownwares in the area. Future researchers now have a compositional baseline from which to work.

7

CHIPPED STONE AND GROUND STONE

by

Chris Lowry

This chapter outlines the methods used and analyses performed on the chipped and ground stone recovered during the Tobin Well Project. General information on the lithic assemblage and the data collected during analysis is presented first, followed by more detailed information concerning raw materials, debitage, and formal tools. Data is primarily descriptive, though more detailed information is presented where relevant. No chronological studies were attempted for the lithic assemblage because the available sample size from reliably dated sites was small and sites with good dates contained little lithic material. One site (41EP4719) contained most of the lithic material for the project (more than 1,000 pieces), while other sites contained little lithic material—sample size biases surely would affect any comparisons.

Chipped and ground stone material documented during Project 91-14 investigations total 3,298 specimens. Surface collections account for 1,103 lithic artifacts, while tested sites yielded a total of 2,195 lithic artifacts.

Procedures

Recording of chipped stone items included pertinent bag information (bag number, provenience, etc.) and information on the following specific lithic variables that will aid in understanding the types of lithic technology used by the prehistoric inhabitants of the region:

- Percent of cortex: either primary (more than 50%), secondary (less than 50%), or tertiary (no cortex)
- Material type: categorized according to standard Fort Bliss material types
- Measurements: length, width, and thickness. If the flake orientation was known, the length was measured accordingly; otherwise, length was the longest axis. Width was measured perpendicular to length. Thickness was measured at the thickest point of the flake.
- Flake outline: the general shape of the flake (round, square, triangular, rectangular, irregular, or oval)
- Platform: absent (crushed), or none
- Platform angle: measured in degrees using a special measuring chart (Wilmsen 1970)
- Bulb attributes: recorded by general size—heavy, moderate, slight, or

none. A slight bulb is less than 2 millimeters, a moderate bulb is greater than 2 millimeters and less than 4 millimeters, and a heavy bulb is greater than 5 millimeters.

- Dorsal flake scars: number of scars on the dorsal surface of the flake
- Use wear: attrition, battering, polish, smoothing, striated, or none
- Comments: any other relevant comments concerning the analyzed flake, for example, chert color, burning, etc.

For pieces that were not large enough to measure (generally less than 10 millimeters), only bag information was recorded.

Measurement of ground stone artifacts followed a similar procedure of recording all pertinent bag information and the following variables:

- Material type: categorized according to the standard Fort Bliss material types
- Size code: recorded utilizing a size chart of concentric circles graduated in 1-centimeter intervals
- Evidence of burning: either burned or unburned; those that were burned were weighed
- Comments: any other pertinent information

Raw Material Analysis

To gain some insight into the types of raw materials used by prehistoric inhabitants of the region, a general analysis of the recovered raw lithic materials was performed. Possible source locations are identified by outcrop within the more mountainous areas of the region. Following these descriptions are a detailed breakdown of the number of raw materials found during the project and the frequency of raw materials by artifact class. A more in-depth treatment of raw material procurement is available in Carmichael (1986) and Camilli et al. (1988).

The alluvial fan deposits of the southern Franklin Mountains region may have been a main source of ground stone and, to a lesser degree, flaked stone used by the prehistoric inhabitants throughout the project area. The majority of all lithics documented from the Tobin Well Project are materials that occur as outcrops in the Franklin Mountains and downslope on the Fusselman Canyon alluvial fan. Stone types include basalt, dolomite, granite, limestone, quartzite, and rhyolite (Harbour 1972). Upslope, at a distance of approximately 3 kilometers from the project area, identical materials are found as gravels.

Prehistoric inhabitants may have used the northern Franklin Mountains lithic sources for its chert. These outcrops and fan deposits begin approximately 20 kilometers northwest of the project area and extend to 35 kilometers. South of this locale, cherts are found near the Texas-New Mexico state line, but these generally are lower quality, fractured outcrops and gravels, making them less suitable for flaked stone tools. To the north along the eastern slopes of the northern

Franklin Mountains, better quality gravels and cobbles are found in the mountain outcrops and alluvial fans. The fan deposits from this area contain localized chert distributions downslope from mountain outcrops, a situation frequently encountered in the region's alluvial fan deposits. Immediately upslope, good to excellent quality cherts, ranging from tan to brown to gray to black are present. All these cherts exhibit varying color combinations of solids, bands, and mottles.

Polychromatic cherts, jaspers, chalcedonies, and obsidians are distributed ubiquitously as pebbles and gravels along the lower flanks of the North Franklin alluvial fan slopes and widely scattered among the desert floor sediments. They are found today 0.5 kilometers east of the project area and continue throughout the Hueco Bolson desert floor. At least two geological events deposited obsidian nodules and desert floor gravels: the deposition of colluvium from the Pleistocene lake Cabeza de Vaca and the movement of the ancestral Rio Grande through the Hueco Bolson.

The Hueco Mountains approximately 20 kilometers east of the project area contain very distinctive mauve, orange, pink, purple, and white mottled chert outcrops. These unique colors are the result of compositional impurities in the silicified stone. The presence of some outcrops in the contact zones of later igneous intrusions naturally modified both color and crystalline structures. Additionally, these micro- and cryptocrystalline materials subsequently became highly vitrified through this heat treatment. Other chert colors found in the Hueco Mountains, its outlying hills, and alluvial fan gravels are white, tan, brown, gray, and black.

In addition to the above sources, prehistoric inhabitants may have exploited other raw material sources in the Organ Mountains, the Jarilla Mountains, and the Sacramento Mountains.

Chert, quartzite, and rhyolite dominate the raw materials (including ground stone) in the Tobin Well Project area (Table 7.1). A varied category composed of very small shatter and flakes overwhelms all these numerically (N = 1,027) but detailed analytical information on raw material type is lacking, thus this information is not included in Table 7.1. Most chert in the assemblage came from two midden features, and the raw materials within the project area were probably obtained from the southern Franklin Mountains. The cherts may have been obtained either locally (from available gravel nodules) or from sources more distant, for example, the northern Franklins or other locales.

Table 7.1. Raw Materials.

Material Type	#	%
Basalt	84	3.69
Chalcedony	29	1.28
Chert	702	30.89
Dolomite	18	0.79
Granite	104	4.58
Limestone	167	7.35
Obsidian	79	3.48
Quartzite	542	23.86
Rhyolite	459	20.20
Sandstone	44	1.94
Schist	31	1.36
Shale	1	0.04
Unknown	12	0.53
Total	2,272	99.99

Raw materials represented in artifact classes (Table 7.2) show few outstanding patterns. Both crystalline volcanic and cryptocrystalline stone show nearly equal percentages for small debitage and flakes. Utilized flake materials are primarily cherts and chalcedonies, possibly indicating a use of these materials for work requiring sharp edges. Tool materials show a weak preference for cherts and chalcedonies over more durable materials of rhyolite, although the project recovered only six tools, making any inference tenuous. Projectile points are overwhelmingly manufactured from cherts and obsidians. Cores are split between cryptocrystalline-glassy volcanic materials and crystalline volcanics-quartzites and limestones. Finally, hammerstones are all manufactured from durable crystalline volcanic materials and quartzites; ground stone, though not in these tabulations, follows this pattern.

Table 7.2. Raw Materials per Artifact Type.

Artifact Type	Raw Material							
	CVOL[1] %	CCS[2] %	GVOL[3] %	Quartzite %	Limestone %	Sandstone %	Varied %	Total %
Angular debitage	7.54	7.61	0.31	3.02	3.02	0.07	22.49	44.06
Utilized debitage	0.07	0.07	–	–	–	–	–	0.14
Tested pebble	0.03	0.21	0.03	–	0.03	–	–	0.30
Flake	9.66	13.90	1.77	7.57	1.91	0.03	13.70	48.54
Utilized flake	0.76	2.64	0.42	0.87	0.07	–	–	4.76
Unimarginal retouch	–	0.10	–	–	–	–	–	0.10
Bifacial retouch	0.03	–	–	–	–	–	–	0.03
Projectile point	–	0.10	0.10	–	–	–	–	0.20
Core	0.31	0.69	0.07	0.28	0.10	–	–	1.45
Hammerstone	0.45	–	–	0.24	–	–	–	0.69
Total	18.85	25.32	2.70	11.98	5.13	0.10	36.19	100.27

[1] crystalline volcanic stone: basalt, rhyolite, and granite
[2] cryptocrystalline stone: chert and chalcedony
[3] glassy volcanic stone: obsidian
Note: Ground stone not included in tabulation.

Chipped Stone Analyses

The Tobin Well Project analyzed a total of 2,879 pieces of chipped stone; 1,334 pieces of recovered microdebitage were not subjected to intensive analysis. Most of the chipped stone assemblage comprises unmodified flakes and angular debris (Table 7.3).

Debitage

Lithic debitage can be an important indicator of stone tool technology and use (Collins 1975; Fish 1981; Magne 1989). Analyses of Tobin Well debitage attempted to extract patterns that might be present within the lithic assemblage and relate them

to the overall cultural system. Single variables were examined first followed by comparisons of two variables.

Table 7.3. Chipped Stone.

Artifact Type	#	%
Debitage	621	21.57
Utilized debitage	4	0.14
Tested pebble	9	0.31
Flake	1,005	34.91
Utilized flake	137	4.76
Unimarginal retouch	6	0.21
Bifacial retouch	1	0.03
Projectile point	6	0.21
Core	42	1.46
Hammerstone	21	0.73
Varied	1,027	35.67
Total	2,879	100.00

The amount of cortex was recorded for all analyzed pieces (Figure 7.1). The varied category was excluded from analysis. Tertiary flakes make up 81.8% of the assemblage; 14.6% are secondary flakes, and 3.6% are primary. The large number of tertiary flakes indicates late stage reduction (Magne 1985, 1989; Mauldin and Amick 1989), possibly for tool blanks or biface thinning and/ or resharpening. The low percentage of earlier stage reduction flakes indicates probable reduction of cores at areas where raw materials were acquired, for example, quarries or cores scavenged from other sites.

The presence or absence of a platform was recorded for all flake material (Figure 7.2). Six-hundred and thirteen (21.7%) flakes have platforms, 1,801 (64.4%) have no platform, and 389 (13.9%) have remnant (crushed) platforms. These data indicate a preference for soft-hammer versus hard-hammer percussion (Whittaker 1994).

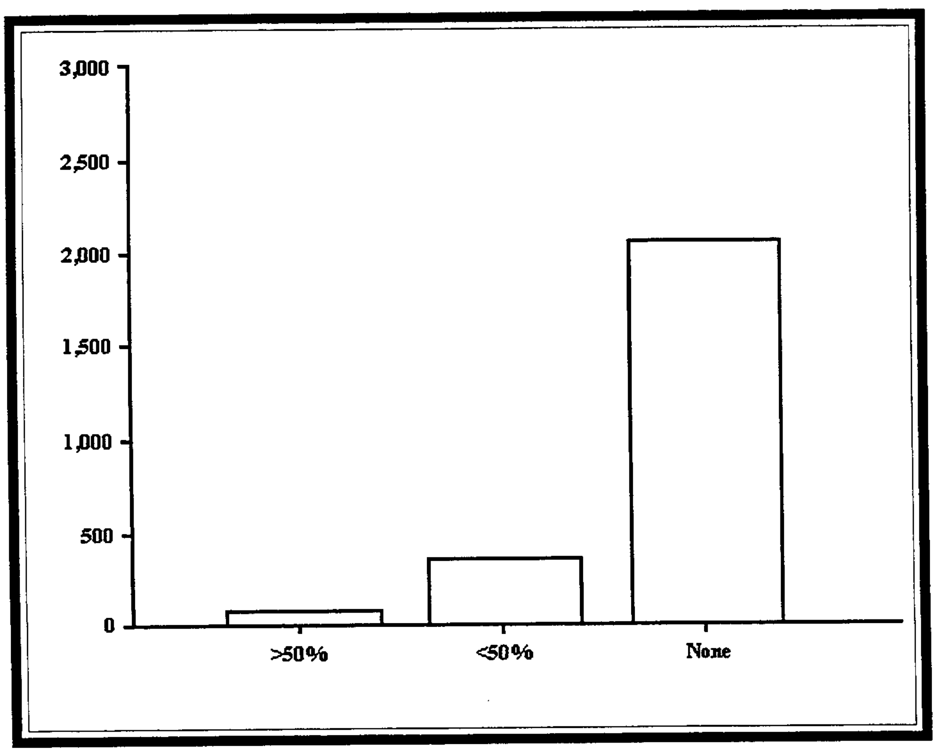

Figure 7.1. Debitage Cortex.

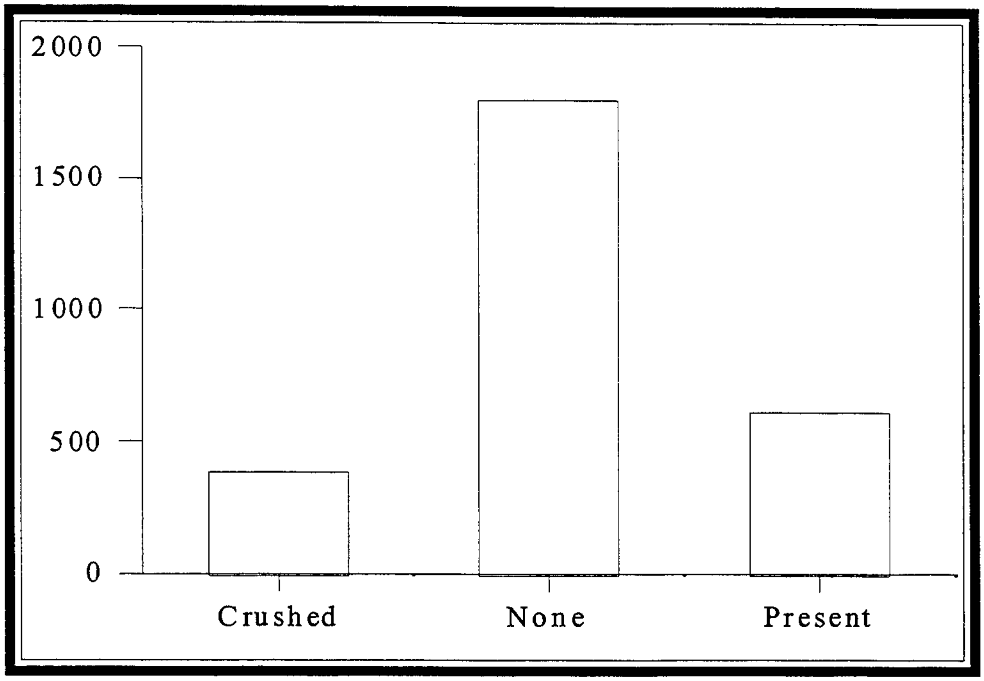

Figure 7.2. Debitage Platform Types.

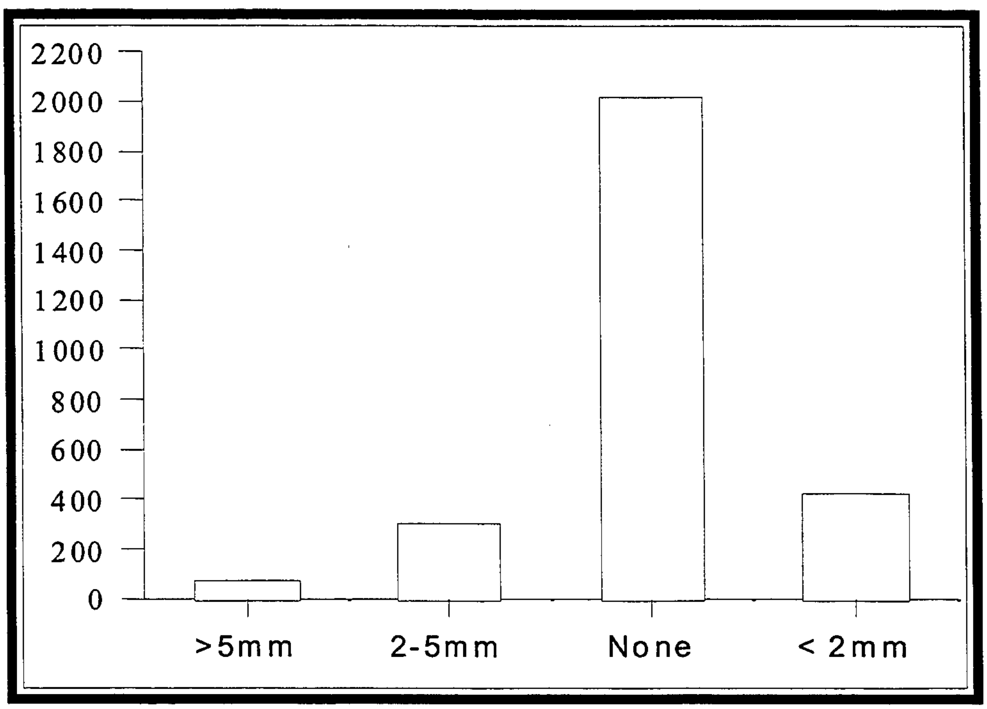

Figure 7.3. Debitage Bulb Types.

Table 7.4. Dorsal Scars, Debitage.

Dorsal Scars	#	%
0	2,374	84.69
1	153	5.46
2	125	4.46
3	78	2.78
4	34	1.21
5	14	0.50
6	10	0.36
7	8	0.29
8	1	0.03
10	1	0.03
11	2	0.07
12	1	0.03
14	1	0.03
15	1	0.03
Total	2,803	99.97

Table 7.5. Dorsal Scars per Cortex Type.

# of Scars	Cortex Type		
	Primary	Secondary	Tertiary
1	8	52	93
2	4	34	87
3	2	15	61
4	1	6	27
5	1	6	7
6	0	6	4
7	1	1	6
8	0	1	0
10	0	0	1
11	0	1	1
12	0	1	0
14	0	1	0
15	1	0	0

Bulb type also was recorded for each flake (Figure 7.3). No bulb is present on 71.9% of the flakes examined; 14.9% have a slight bulb (< 2 millimeters), 10.7% have a moderate bulb (2 to 4 millimeter), and 2.4% have a heavy bulb (> 5 millimeters). These data corroborate the platform data in that soft-hammer percussion appears to be the preferred technique for working available stone (Whittaker 1994).

Dorsal flake scars are another attribute examined during analysis of the lithic assemblage. More than 84% of the examined flakes have no flake scars (Table 7.4), suggesting no preparation of the flake before removal from the core. These data show an overall decline in the number of scars for flakes, suggesting that very little preparation was done on the flake before it was struck. This pattern is confirmed in that more flake scars are expected on later stage flakes (Magne 1985, 1989). Examination of the number of dorsal scars by cortex type indicates that, in general, more scars are found on later stage flakes (Table 7.5). Mauldin and Amick (1989), however, point out that this variable is not a good indicator of overall reduction strategy.

Platform angle or flake angle recorded for all flakes revealed an overwhelming number of flakes (2,027 or 78.3%) that could not be measured because of missing or crushed platforms. The other 596 pieces were measured and the distribution of angles plotted on a bar graph (Figure 7.4). Flake angles equal to or greater than 90 degrees usually indicate the use of increased outward force applied to the platform and produce flakes that closely resemble blades. Angles less than 90 degrees usually indicate greater inward force exerted upon the platform and produce the smaller flakes found in bifacial

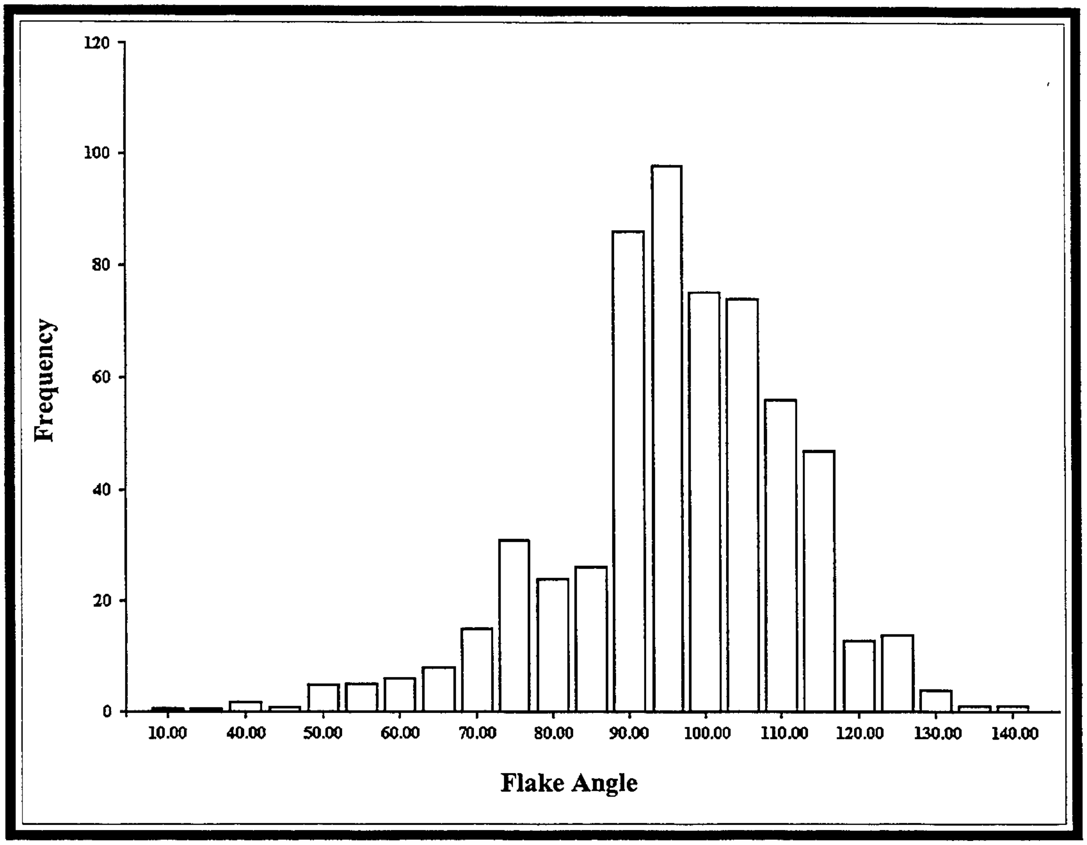

Figure 7.4. Flake Angles.

thinning (Wilmsen 1970). The large number of flakes exhibiting angles greater than 90 degrees may indicate the use of expedient flake tools rather than formal tools such as bifaces or marginally retouched tools.

Analysis of the above variables indicates a later reduction sequence for the Tobin Well debitage rather than initial core reduction. This implies that the initial core reduction took place away from the immediate project area, perhaps at quarrying locations or other specialized areas. Because the typology used in this analysis did not differentiate between bifacial thinning flakes and pressure flakes, it is unknown if bifacial thinning and production were done within the project area. Most small flakes and shatter came from two midden features on 41EP4719. This site also contained the remains of a late Formative pit structure. It is possible that more intensive tool manufacture and reduction took place at this site. Camilli et al. (1988: 6–21) note that flakes removed from decorticated cores dominated lithic production on the West Mesa and that biface production and maintenance appeared minimal.

Formal Lithic Tools

Ten prehistoric sites contained 13 formal flaked stone tools (Table 7.6). Sites 41EP379, 41EP380, and 41EP4714 each contained one unimarginal retouch tool; 41EP4713 contained one projectile point; 41EP4719 contained a unimarginal retouch

Table 7.6. Formal Tools.

Site #	Fea. #	Tool	Material	Length (mm)	Width (mm)	Thickness (mm)	Comments
8004		Unimarginal retouch	Rhyolite	33.13	23.50	4.87	Gray-peach color
8007		Unimarginal retouch	Rhyolite	49.08	31.75	13.32	Black-peach color
12409		Projectile point	Chert	33.12	60.70	7.30	Tan-brown color
12410		Unimarginal retouch	Chalcedony	25.43	23.06	5.27	Yellow color
12411		Unimarginal retouch	Rhyolite	26.04	20.05	6.03	
12429		Unimarginal retouch	Chert	40.85	32.09	9.69	Tan color
12429		Projectile point	Chalcedony	12.97	7.83	1.69	Tip only
12429	26	Projectile point	Obsidian	14.37	9.77	1.84	Complete
12432		Bifacial retouch	Rhyolite	85.34	79.37	50.24	
12441		Projectile point	Obsidian	13.75	7.91	1.87	Side notched
12441	36	Projectile point	Obsidian	17.81	7.85	3.32	Base only
12444		Unimarginal retouch	Chert	24.26	28.09	7.63	Brown color
12451		Projectile point	Chalcedony	20.32	13.92	3.89	Complete

flake and two projectile points. Site 41EP4722 contained a bifacial retouch flake and 41EP4734 contained a unimarginal retouch flake. Two projectile points were recovered at 41EP4731, and at 41EP4741 one projectile point was found.

Only four of the forty-eight sites recorded during the fieldwork of this project contained projectile points. The lack of projectile points on the remaining sites and among isolated finds in the project area may suggest scavenging and reuse by later aboriginal groups or special use functions other than hunting. Further, formal tools such as bifaces and projectile points are targets of collectors and their overall low numbers in the Tobin Well artifact database may be the result of collecting that began in the area in the 1930s.

Several unimarginal tools are manufactured from rhyolite material, suggesting the need for a durable cutting edge. All the projectile points are made of easily flaked cryptocrystalline materials such as chert, chalcedony, and obsidian.

A most interesting pattern observed for the Tobin Well data is the ratio of formal tools to utilized flakes. One-hundred and thirty-seven flakes exhibit signs of use while the project documented only 13 formal tools. This comes out to a ratio of 10.5 to 1, suggesting more reliance on informal, expedient tools than on more formally constructed tools. Parry and Kelly (1987) note that such a pattern appears common throughout most of North America and Mesoamerica. Formal tools require increased labor to manufacture and maintain, as well as good quality material. Production technique is not easily learned and requires practice before usable bifaces can be made. Expedient flake tools, however, are easily manufactured, require little training to produce, and, once used, are usually discarded. Other factors to consider include temporal and spatial differences of tool manufacture, use, reuse, and discard. Variability in tool manufacturing

techniques and morphology should be viewed in the context of the tool's ability to meet anticipated and unanticipated needs. Further, the ability to find suitable raw materials when situational needs arise is also important (Parry and Kelly 1987: 300). Parry and Kelly (1987: 297) suggest that a reduction in mobility may be a prime factor in this pattern. They argue that:

> The production of formal tools from standardized cores should be common in the lithic technology of residentially mobile populations, because of the need to transport lithic materials (in the form of tools) from their sources to the places where they will be used. Among sedentary populations, portable tools would no longer have such a high degree of utility, so it is not surprising that sedentary groups throughout North America ceased to invest much effort into producing formal tools, and instead chose to emphasize expedient use of unretouched flake tools (Parry and Kelly 1987: 304).

Further, Parry and Kelly (1987: 304) stress the importance of viewing this change, not as devolution, but as "a strategic decision to reduce the effort invested in creating and maintaining the stone tool kit in the context of changing needs and changing allocation of resources."

The Tobin Well data, though very general in nature, suggest that group mobility, especially in later Formative times, was reduced and the ratio of formal tools to expedient flake tools reflects such a reduction. Because sample sizes are not nearly large enough and the chronological data available for this project are scant, further work is needed with a larger sample of chronologically controlled data for sites in a much larger region to confirm such a hypothesis.

Cores

The Tobin Well Project recovered 42 cores. Of these, 50% (N = 21) came from feature contexts. By material type, 47.6% (N = 20) are cryptocrystalline stone, and 40.5 (N = 17)% are crystalline volcanic material. Glassy volcanic materials account for 4.76% (N = 2) and 7.14% are limestone (N = 3). The mean length of recovered cores is 43.59 millimeters, mean width is 33.15 millimeters, and mean thickness is 21.55 millimeters. The mean number of scars for recovered cores is 6.57. The low overall mean size of recovered cores suggests two possibilities: (1) cores were reduced as far as possible, maximizing the number of flakes that could be produced, or (2) scavenging of available cores was common when specific raw materials were required.

To test this, size means were computed separately for crystalline volcanic materials and cryptocrystalline stone. The premise is that easily available crystalline volcanic cores such as basalt, quartzite, and rhyolite should exhibit larger overall size compared with rarer cryptocrystalline cores such as cherts and chalcedonies. The size means for crystalline volcanic cores are: length, 53.63 millimeters; width, 41.20 millimeters; and thickness, 27.70 millimeters. Mean sizes for cryptocrystalline stone cores are: length, 36.37 millimeters; width, 27.04 millimeters; and thickness, 17.34 millimeters. As these data show, the premise of larger, easily available core material is correct. The prehistoric inhabitants probably reduced rarer cryptocrystalline materials as much as possible before discarding them and reduced more

easily available raw materials to a much lesser degree. Thus, it appears that they practiced conservation of rarer raw materials and that scavenging of such material was probably common.

Hammerstones

The Tobin Well Project recovered 21 hammerstones with battering over part or all of the outer surface. Of these, 19.0% ($N = 4$) came from feature contexts. All are crystalline volcanic material (6 granite, 7 quartzite, and 7 rhyolite). The mean length is 71.20 millimeters, mean width is 56.97 millimeters, and mean thickness is 40.81. Not surprisingly, all the recovered hammerstones are made of durable raw materials suitable for reducing nearly any other type of stone.

Use Wear Analysis

Use wear on all the recovered lithic material was examined using a 10-power hand lens. Normally use wear studies use higher power microscopes and more intensive analyses of larger sets of variables; therefore, this analysis gives only a general picture of the types of use wear and possible tool function for the Tobin Well lithic assemblage.

One-hundred and thirty-seven flakes exhibit some type of use and 25 tools (hammerstones and some formal tools) also show signs of use. Most flakes (94.3%) have no use wear (Table 7.7). Attrition is the most prevalent use wear noted, followed by smoothing. Attrition is associated primarily with sawing or cutting motions on hard surfaces such as wood or bone. These motions produce striations as well. Contact with softer surfaces such as occurs when cutting meat or vegetation or scraping hides produces smoothing and polishing. Repeated striking of one hard surface against another as in hard hammer percussion or pecking for shaping ground stone tools produces battering (Ahler 1979; Odell 1979). The Tobin Well data suggest that expedient tool uses involved a variety of purposes including scraping, cutting, and sawing. Three of the recovered unimarginal tools exhibit smoothing, suggesting use as hide scrapers or meat or plant knives, and one unimarginal tool exhibited attrition, suggesting use as a saw for cutting wood or bone. In reality, the formal tools probably had many different purposes. The expedient flake tools may have had multiple uses as well. However, their greater numbers suggest that they may have been used once and then discarded.

Table 7.7. Use Wear Types (All Lithics)

Use Wear Type	#	%
Attrition	67	2.33
Battering	23	0.80
Polish	11	0.38
Smoothing	36	1.25
Striation	27	0.94
None	2,715	94.30
Total	2,879	100.00

Ground Stone

The Tobin Well Project recovered and analyzed 419 pieces of ground stone (Table 7.8). Single-handed, unifacial and bifacial manos, mano fragments, metates, metate fragments, mano/metates, and many unidentified ground stone fragments comprise the

total assemblage. Some of these tools have evidence of pounding and others have modified acute angle edges. Cutting and scraping activities may account for the latter. The types of ground stone tools recorded within the project area suggest small-scale plant processing.

Table 7.8. Ground Stone Artifacts.

Artifact Type	#	%
Mano	6	1.43
Mano fragment	12	2.86
Metate	2	0.48
Metate fragment	33	7.87
Mano/metate	2	0.48
Mano/metate fragment	7	1.67
Other ground stone	357	85.20
Total	419	99.99

The project assemblage contains only basin and slab metate fragments. No trough metate fragments were recorded. Metates and manos tend to lack edge shaping, having only the ground surfaces modified, indicating that naturally shaped, suitable forms were selected from the alluvial fan gravels and modification was restricted to the grinding surface(s). It is possible that wild plants and possibly cultivated plants were processed within the project area. Small game also may have been prepared with these ground tools.

The project recovered six complete manos and only two complete metates through both surface and subsurface testing. This may suggest a combination of intensive stone recycling by the prehistoric inhabitants for grinding tools as well as recycling of broken ground stone pieces for heat-related feature use. Two other scenarios are possible: (1) collectors have removed some whole specimens from the project area or (2) the prehistoric inhabitants cached such tools at other locations. Ethnographic data show that some groups transported grinding stone with them to use at new camps. However, they generally cached or abandoned metates because of the large size and weight. The occurrence of metate fragments for Tobin Well is greater than that of mano fragments, suggesting the abandonment of metates when groups moved to a new location.

Nearly all the ground stone recovered (396 pieces or 96.8%) in the project area showed evidence of burning, indicating that it was recycled as hearth rock. Examination of raw material types for ground stone (Table 7.9) shows that quartzite is the most common material used for ground stone items, followed by granite and sandstone. Tabulated weights for material types (Table 7.9) show, as expected, the dominant types are also the ones with the highest total weights. Material type by artifact type shows no outstanding pattern. Examination of ground stone size shows that most whole pieces were small, indicating portable implements.

Table 7.9. Ground Stone Materials.

Material Type	#	%	Weight (g)	Weight (%)
Basalt	22	5.25	1,443.55	4.09
Dolomite	18	4.30	714.33	2.02
Granite	51	12.17	11,121.72	31.48
Limestone	19	4.53	1,881.03	5.32
Quartzite	197	47.01	14,844.76	42.02
Rhyolite	28	6.68	1,232.84	3.49
Sandstone	41	9.79	2,960.63	8.38
Schist	31	7.40	1,060.85	3.00
Shale	1	0.24	69.95	0.20
Unknown	11	2.63	0.00	0.00
Total	419	100.00	35,329.66	100.00

Discussion

The limited nature of the analyses conducted on the Tobin Well lithic material allows for assessment of only a few of the theoretical expectations outlined in Chapter 3. First, assemblage diversity is low and overall assemblage size is small. Though no formal analyses bolster this claim, the data lend some support to the suggestion. Most sites contained only a few lithic flakes, debris, and formal tools, and most sites contained only a few artifact classes. Such a pattern indicates either foraging-logistical locations and temporary travel camps or short-term residential bases.

Second, formal analytical data for assemblage size and site area are lacking. However, the general trend appears to show that small assemblage size is equivalent to small site area, and the largest sites contain the highest number of artifacts. This pattern also points to some type of foraging-logistical-travel camps, though a few sites qualify as residential bases.

Raw material analyses indicate a preference for local stone for most sites, though some sites (for example, 41EP4716 and 41EP4719) show a trend for nonlocal materials. Again, the pattern indicates both foraging or short-term residences, as well as logistical and travel camps.

Manufacturing stages indicated through debitage analyses point to late stage reduction of lithic material with some early reduction noted (41EP4716). This suggests both foraging and logistical locations and semipermanent residential bases.

For anticipated or situational technology, the Tobin Well data indicate a larger ratio of expedient (situational) flakes to anticipatory (formal) tools. Core size suggests recycling of nonlocal cherts, hence their smaller average size. These data, again, suggest both aspects of forager and collector systems.

Little data exists from these analyses to address the other expectations, though, in general, it appears that most sites show indications of reoccupation, while others may have been used multiple times. Overall, the lithic data for Tobin Well suggest the presence of both forager and collector system components. Such a suggestion is warranted given the postulations about past cultural systems using the Hueco Bolson (see Chapter 3). The chronological control needed to separate these factors is lacking for this data set, primarily because solid chronological control for a good sample of sites is missing.

Summary

In all, the Tobin Well Project recovered 3,298 pieces of chipped and ground stone. Most raw materials appear to originate in local outcrops near the project area, though other sources were almost certainly exploited. Utilized expedient flakes were generally manufactured from cryptocrystalline materials rather than from other material types.

Analysis of the Tobin Well debitage shows a late reduction sequence; little primary core reduction appears within the assemblage. Few projectile points and formal

tools were recovered during the project survey and testing. Factors to account for this include heavy collection in the past by pot-hunters or few hunting and processing activities within the project area. Tools were also curated items and as such are generally not as ubiquitous in the archaeological record as debitage.

The high ratio of utilized flakes to formal tools suggests that expedient flake technology was more common than formal tool technology. One reason for this is a reduction in mobility in late Formative times. Core size varies by material type—local core material, overall, is larger than the rarer cryptocrystalline material. This may point to conservation of certain lithic material. The general use wear analysis indicates a variety of activities within the project area, including sawing, scraping, and cutting of various materials.

Ground stone pieces are predominantly quartzite. Further, more than 96% of the ground stones show signs of recycling as hearth rock. Overall, ground stone tools are small and portable, suggesting small-scale processing activity.

8
SUBSURFACE TESTING AND FEATURES

by

Chris Lowry

This chapter presents the results of subsurface testing and excavation of features in the Tobin Well Project area and the results of specialized analyses. The first section of the chapter presents descriptive information concerning subsurface testing. The next presents descriptive feature information, feature artifact associations, and a burned rock analysis. The last section presents the results of radiocarbon, obsidian hydration, macrobotanical, and faunal studies; artifact size analysis; and an analysis of regional pit structure variability.

Subsurface Testing Data

Subsurface testing of portions of 16 archaeological sites at Tobin Well resulted in the recovery of several thousand artifacts (Table 8.1). One site tested, 41EP1610, contained no subsurface artifacts or features and is not considered further in this report. One site, 41EP4719, contained more than 3,000 artifacts and five other sites contained between 200 and 500 artifacts. All other tested sites contained a low density of material—less than 100 artifacts. A total of 279 1-by-1-meter units (Figure 8.1) excavated within tested sites removed 74.9 cubic meters of fill from the excavated units.

By artifact type, fire-cracked rock makes up the majority of recovered material followed by nearly equal amounts of debitage and flakes. Only 200 pieces of burned caliche were recovered and fewer than 70 specimens represent all other nonceramic artifact types. Pottery is overwhelmingly undifferentiated brownware followed by painted El Paso wares. Playas Red dominates the intrusive wares; only one Chupadero Black-on-white sherd was recovered. All other intrusive wares are unknown plain, unknown textured, and unknown painted wares.

Features

Eighteen subsurface features discovered and excavated during the testing phase of the project include eleven hearths, two structures, one borrow pit (possible structure), two middens, and two postholes (Table 8.2). The following subsections describe excavated features in more detail. Feature dates are corrected.

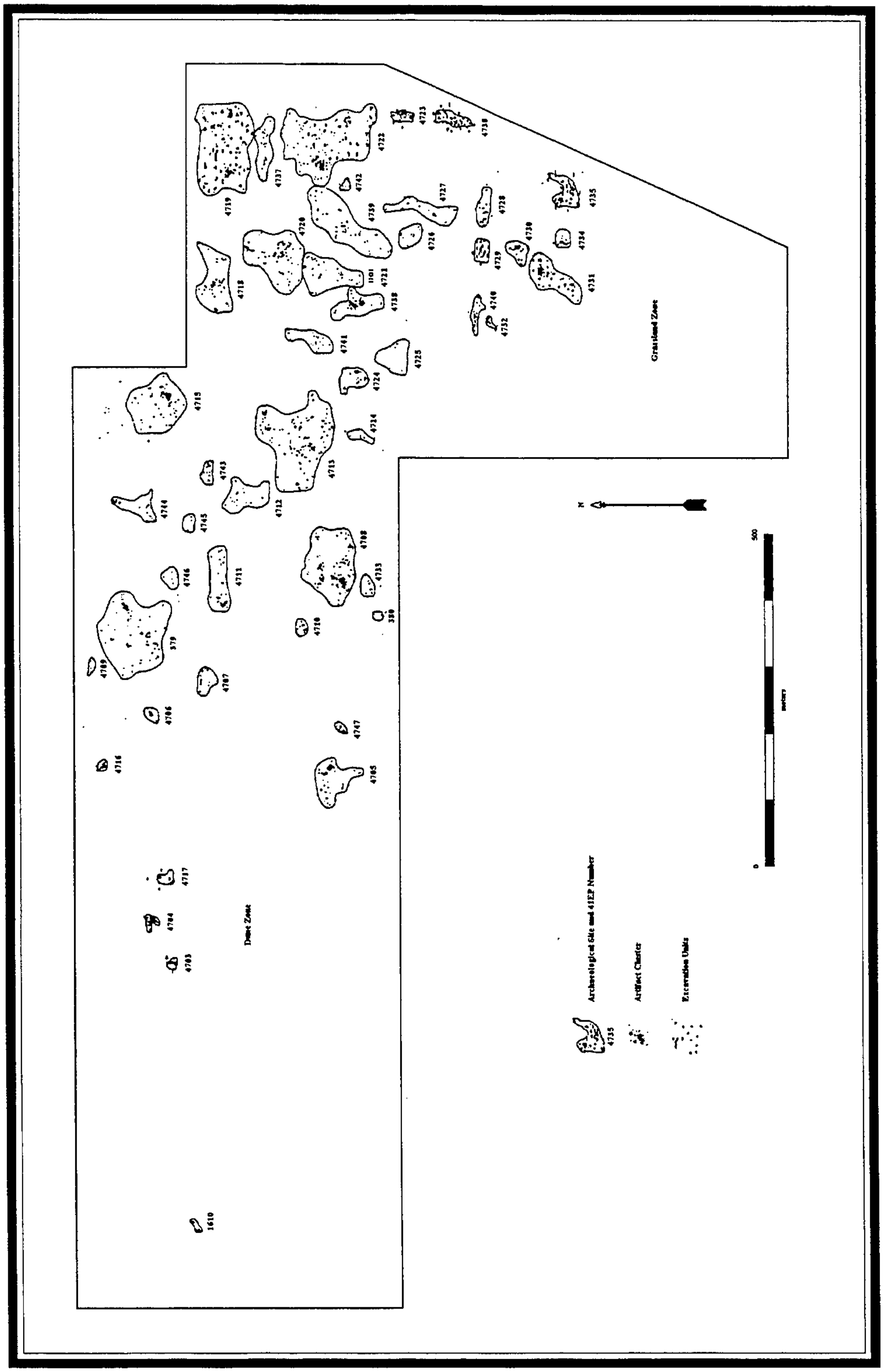

Figure 8.1. Extent of Archaeological Investigations.

Table 8.1. Artifacts from Tested Sites.

Site Number	Feature	Debitage	Flake	Utilized Flake	Tool	Core	Hammerstone	Ground Stone Tool	Ground Stone Fire-Cracked Rock	Fire-Cracked Rock	Burned Caliche	Undifferentiated Brownware rim	El Paso Polychrome	Other Ceramics	Total
41EP4703	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
41EP4704	2	0	3	1	0	1	1	4	12	196	186	0	0	0	404
41EP4717	1	0	10	0	0	0	0	0	1	228	0	0	0	0	239
41EP4719	6	771	778	48	1	6	0	0	21	1,149	17	279	75	56	3,201
41EP4722	2	6	75	4	0	0	2	2	0	68	0	44	7	1	209
41EP4723	0	0	3	0	0	0	0	0	1	4	0	0	0	0	8
41EP4728	0	0	8	0	0	0	0	0	0	4	0	5	0	0	17
41EP4729	0	4	9	0	0	0	0	1	0	47	0	0	0	0	61
41EP4730	0	2	0	0	0	0	0	1	0	0	0	0	0	0	3
41EP4731	4	108	60	1	2	9	0	0	27	238	4	75	0	0	524
41EP4732	0	0	0	0	0	0	0	0	0	7	0	0	0	0	7
41EP4734	1	124	65	3	1	1	0	1	0	116	0	50	1	1	363
41EP4735	2	2	3	0	0	0	0	0	3	52	0	10	7	0	77
41EP4736	0	1	3	0	0	0	0	0	0	0	0	19	1	0	24
41EP4737	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Total	18	1,018	1,017	57	4	17	3	9	66	2,109	207	483	91	58	5,139

Hearths

Eleven subsurface hearths excavated during testing at Tobin Well range in size from 45 centimeters to 1.6 meters in diameter; average size is 83.9 centimeters in diameter. All tested hearths are basin shaped and range in depth from 7 to 30 centimeters; average depth is 16.9 centimeters. Of the tested hearths, nine have radiocarbon dates. Three hearths date to the late Archaic period, four to the early Formative period (Mesilla phase), and two to the late Formative period (El Paso phase).

Structures

41EP4719, Feature 28

Feature 28 was partially excavated and some measurements are approximations. The feature is a large, deep, square-shaped structure measuring 2.20 by 2.25 meters by 45 centimeters deep. Floor area is approximately 4.95 square meters. The builders excavated the structure into the caliche substrate and it had nearly perfect vertical walls. Two postholes (Features 29 and 30) in the western third of the structure possibly indicate a four-post plan. No floor hearth was noted, but it may be buried in the unexcavated part of the structure. No entryway or other floor features were uncovered. Artifacts found in the fill include three brownware sherds and lithic debitage of rhyolite, quartzite, chalcedony, chert, and obsidian. Fire-cracked rock, burned caliche, bone fragments, and a shell bead also were recovered. Most artifacts show evidence of burning. A

Table 8.2. Tested Features.

Site #	Fea. #	Type	Shape	Dimensions	Depth
41EP4704	7	Hearth	Basin	62cm	20cm
41EP4704	8	Hearth	Basin	46cm	11cm
41EP4717	24	Hearth	Basin	75cm	30cm
41EP4719	25	Midden	Unknown	10 sq.m	34cm
41EP4719	26	Midden	Unknown	Unknown	18cm
41EP4719	27	Hearth	Basin	50cm	10cm
41EP4719	28	Structure	Square	5.5 sq.m	45cm
41EP4719	29	Posthole	Round	20cm	>20cm
41EP4719	30	Posthole	Round	20cm	>20cm
41EP4722	32	Structure	Square	4.3 sq.m	20cm
41EP4722	33	Hearth	Basin	70cm	7cm
41EP4731	36	Hearth	Basin	150cm	15cm
41EP4731	37	Hearth	Basin	160cm	20cm
41EP4731	38	Hearth	Basin	100cm	15cm
41EP4731	39	Hearth	Basin	62cm	10cm
41EP4734	42	Hearth	Unknown	2 sq.m	20cm
41EP4735	43	Hearth	Basin	60cm	11cm
41EP4735	44	Pit	Round	140cm	40cm

radiocarbon date of 860 ± 80 B.P. (1046–1276 A.D.) for the structure fill indicates a mid-Formative period occupation.

41EP4722, Feature 32

Feature 32 was completely excavated. The structure was a large, shallow, square-shaped structure measuring 2.10 by 2.00 meters by 20 centimeters deep. Floor area is approximately 4.20 square meters. The builders had excavated most of the structure into the caliche substrate and it had nearly vertical walls. A floor hearth measuring 60 centimeters in diameter by 5 centimeters deep was in the southeastern corner. The hearth contained a light gray ashy fill with burned caliche chunks. One possible post-hole was near the western wall. No entry-way was found. Artifacts found in the fill include flake debitage of rhyolite, chert, quartzite, and chalcedony; a granitic hammerstone; and several sherds of undifferentiated brownware, El Paso Bichrome, and El Paso Polychrome. Most artifacts show evidence of burning. Radiocarbon dates of 730 ± 70 B.P. (1249–1341 A.D., average of two dates) for the structure fill and 860 ± 90 B.P. (1041–1278 A.D.) for the floor hearth indicate a middle to late Formative period occupation.

Middens

41EP4719, Feature 25

Feature 25 is a large, slightly mounded midden at least 10 meters in diameter by 34 centimeters deep at the center and 10 centimeters near the edges. A 1-by-7-meter trench excavated through the feature revealed gray stained ashy sand with large amounts of charcoal. An area of dark gray-black stained sand was in the center of the feature. Artifact density is high with more than 1,300 artifacts recovered, including lithic debitage, ceramic sherds, ground stone, burned caliche, fire-cracked rock, and burned bone. Diagnostic artifacts include El Paso Polychrome and Playas Red sherds. Radiocarbon dates of 955 ± 90 B.P. (1027–1217 A.D., average of two dates) indicate a middle Formative period occupation.

41EP4719, Feature 26

Feature 26 was trenched. The feature is a large sheet midden with a maximum thickness of 18 centimeters and a minimum of 10 centimeters near the edges; exact dimensions are unknown. Soil consists of gray ash-stained silty sand containing large amounts of charcoal. Artifact density is high, with nearly 1,000 items. Artifacts include lithic debitage, ceramic sherds, ground stone, fire-cracked rock, burned caliche, and burned bone. One projectile point and diagnostic ceramic sherds (El Paso

Brown, El Paso Bichrome, and El Paso Polychrome) were recovered. A large hearth (Feature 27), located within the midden has dates similar to those of the midden (690 ± 60 B.P.). Radiocarbon dates of 835 ± 80 B.P. (1104–1279 A.D., average of two dates) for the midden indicate a middle Formative period utilization.

41EP4735, Feature 44

Feature 44 is a nearly circular caliche borrow pit measuring 1.4 meters in diameter. The bottom of the pit, which its users had excavated 25 centimeters into the caliche substrate, was highly irregular, indicating that chunks of caliche had been removed with no effort to smooth the bottom of the pit. The fill of the pit consisted of brown silty sand with large amounts of charcoal. Few artifacts were recovered from the fill. The borrow pit is radiocarbon dated to 510 ± 90 B.P. (1327–1454 A.D.) indicating a late Formative period use.

Discussion

Both structures (Features 28 and 32) and the borrow pit (Feature 44) were excavated into the caliche substrate by their builders. Agenbroad (1985) notes that some Anasazi pit structures were excavated in a similar manner. Most pit structures excavated during the White Mesa project (Davis 1985) also were dug into the surrounding caliche substrate. Agenbroad (1985) suggests that the impermeable rock was a factor. Though tougher to excavate, the caliche bedrock provided increased structural integrity and resisted permeation of ground water, reducing the risk of flooding. The borrow pit discovered during this project may be an uncompleted structure; no internal features were noted and little trash was recovered. Its size, however, corresponds with similar structures found in the El Paso region.

The middens (Features 25 and 26) are notable for the lack of floral and faunal materials. Both are composed primarily of lithic debris, ceramic sherds, fire-cracked rock, and burned caliche, and both date to the middle Formative period. Macrobotanical samples analyzed from both middens at Tobin Well show no traces of cultigens. It may be that insufficient numbers of samples were run to detect plant remains, but the fact that cultigens may not have been utilized at these sites should not be ruled out.

Artifact Associations

Artifact associations were examined for 16 of the 18 features with the hopes of defining patterns in feature types (Table 8.3). Artifacts associated with features are defined as having come from within the feature or from the area immediately surrounding the feature. Hearth features, in general, appear to have a low density of lithic artifactual material associated with them, though there are some exceptions. Ceramic sherds also have a relatively low density near feature areas. Fire-cracked rock is the dominant hearth rock in most cases, with only a few hearths having any burned caliche. Very little bone was associated with these features. The low overall density and diversity of artifacts suggests these feature areas were not used for any length of time and may be temporary or short-term camps.

Middens, not surprisingly, have the highest overall associated artifact density and diversity for excavated features. Most

Table 8.3. Artifacts Associated with Features.

Feature Number	Feature Type	Debitage	Flake	Utilized Flake	Tool	Core	Hammerstone	Ground Stone Tool	Ground Stone Fire-Cracked Rock	Fire-Cracked Rock	Burned Caliche	Undifferentiated Brownware rim	El Paso Polychrome	Other Ceramics	Total
7	Hearth	0	1	0	0	0	1	4	12	183	57	0	0	0	258
8	Hearth	0	2	0	0	1	0	0	0	13	22	0	0	0	38
24	Hearth	0	9	0	0	0	0	0	0	165	0	0	0	0	174
25	Midden	426	362	19	0	5	0	0	1	266	17	182	50	13	1,341
26	Midden	214	194	14	1	0	0	0	11	628	0	23	13	0	1,098
27	Hearth	11	37	0	0	0	0	0	0	60	0	1	0	0	109
28	Structure	22	36	1	0	0	0	0	0	7	0	3	0	0	69
32	Structure	6	53	2	0	0	1	2	0	23	0	37	7	0	131
33	Hearth	0	1	0	0	0	0	0	0	0	0	0	0	0	1
36	Hearth	14	1	0	0	1	0	0	3	0	0	0	0	0	19
37	Hearth	5	3	0	1	0	0	0	1	3	1	22	0	3	39
38	Hearth	16	8	0	0	4	0	0	12	126	3	7	0	0	176
39	Hearth	4	1	0	0	3	0	0	2	35	0	4	0	0	49
42	Hearth	10	6	1	0	0	0	0	0	24	0	1	1	0	43
43	Hearth	0	1	0	0	0	0	0	0	0	0	0	0	0	1
44	Pit	0	1	0	0	0	0	0	0	1	0	9	3	0	14
Total	16	728	716	37	2	14	2	6	42	1,534	100	289	74	16	3,560

of the recovered faunal material also came from these features. Debitage, flakes, fire-cracked rock, and ceramic sherds dominate the assemblage for these features. The high density and diversity of artifacts for these features suggest long-term use.

The structures contained a high diversity of associated artifacts, though the overall density is much lower than the middens. Structures in the Southwest typically serve two functions: (1) as shelters for most of their use lives, and (2) when too old to repair, as trash dumps. Some material recovered from these structures could be related to its initial role as a shelter; however, most of the recovered material was burned suggesting that it was refuse. The fact that these features are recognized as structures suggests residential locations. Further, their method of construction (excavated into caliche substrate) points to a more long-term habitation such as semipermanent or permanent residential bases.

Faunal Associations

The Tobin Well Project recovered very little bone so it was difficult to make determinations about the relationship between features and bone. Of the 144 pieces of bone recovered from subsurface contexts, all but 8 pieces are from feature contexts.

Most of the faunal collection came from a midden on site 41EP4719 (Table 8.4). The number of bones is surprisingly low for the more than 7 square meters excavated in this feature. However, bone from sites excavated in the Hueco Bolson is generally not well preserved, although there are exceptions. Middens are usually used for trash disposal and bone is frequently discarded in such places because organic materials attract vermin and insects. The relationship here appears to be one of less bone associated with smaller features. This assumption is tenuous given the small sample size of features and the number of bones recovered.

Table 8.4. Bones Associated with Features.

Site#	Fea. #	Type	#	%
41EP4719	25	Midden	102	75.0
41EP4719	26	Midden	23	16.9
41EP4719	28	Structure	6	4.4
41EP4731	38	Hearth	3	2.2
41EP4734	42	Hearth	2	1.5
Total			136	100.0

Examination of the relationship of burned versus unburned bone shows 56 pieces of burned bone and 91 unburned. No pattern by feature type is evident in the relationship of burned versus unburned bone. Thus, the faunal results by feature were disappointing.

Burned Caliche and Fire-Cracked Rock

The project recovered several thousand pieces of burned caliche and fire-cracked rock. Burned caliche on the surface was not collected, but was counted in the field. Fire-cracked rock was collected from both surface and subsurface contexts. To examine any patterns that may exist within the fire-cracked rock class, project personnel made an intensive study of the collected pieces analyzing them by material type, weight, and size.

Material types for burned rock indicate a preference for caliche, followed by granite and quartzite (Table 8.5). Schist, rhyolite, basalt, chert, and sandstone round out the numbers of rock types utilized. The varied category includes pieces too small for

Table 8.5. Burned Rock Material.

Material	#	%	Weight (g)	Weight (%)
Basalt	66	1.58	1,785.61	3.76
Caliche (surface)	1,419	33.94	0.00	0.00
Caliche (subsurface)	100	2.39	631.51	1.33
Chert	3	0.07	25.33	0.05
Dolomite	60	1.44	3,414.30	7.19
Granite	1,172	28.03	6,535.47	13.76
Quartzite	352	8.41	19,398.37	40.85
Rhyolite	68	1.63	6,354.17	13.38
Sandstone	7	0.17	1,195.92	2.52
Schist	113	2.70	1,857.77	3.91
Varied	776	18.56	6,291.16	13.25
Unknown	45	1.08	0.00	0.00
Total	4,181	100.00	47,489.61	100.00

analysis. Most materials are available in the nearby Franklin Mountains and Fusselman Canyon area.

By weight, quartzite dominates the burned rock assemblage. This is unusual, as this material represents only 8.4% of the total burned rock. It would appear that quartzite pieces are larger than most other burned rock pieces. Granite, rhyolite, and the varied category follow in weight after quartzite. Caliche occurred primarily on the surface ($N = 1{,}419$) of the Tobin Well sites, while rock occurred most frequently in subsurface contexts ($N = 2{,}109$).

Sizes of recovered burned rock pieces, in general, follow the expected pattern of increasing size-increasing weight (Table 8.6). Some differences in the smallest size and the larger sizes appear to be related to the overall frequency. Burned caliche appears to follow this pattern also, but not enough data is available to make a positive assertion.

Table 8.6. Burned Rock Measurements

Size (cm)	#	Weight (g)
	Burned Rock	
1	1,540	1,461.27
2	214	1,165.46
3	239	1,919.95
4	205	3,879.35
5	142	4,023.01
6	99	4,233.90
7	65	5,176.60
8	38	4,596.11
9	27	6,184.49
10	12	3,301.91
11	2	558.29
12	19	2,953.09
13	11	4,283.99
14	1	519.52
16	1	558.21
17	2	2,042.95
No data	45	
	Burned Caliche	
1	95	40.39
2	1	1.80
3	2	14.47
4	1	5.23
10	1	195.59
12	1	379.26
No data	1,419	

Though no formal experiments and analyses were conducted with the Tobin Well burned rock data, some generalizations can be made based on an informal experiment conducted by the author, as well as formal experiments and data analyses of burned rock by Duncan and Doleman (1991).

Prior to analysis, an informal experiment used caliche and various rock material types from the nearby Franklin Mountains as a lining for a fire pit. A fire utilizing pecan and mesquite wood was kindled and allowed to burn for eight hours. The resulting coal bed was at least 10 centimeters deep and burned for another seven hours. Upon cooling, the ashes were removed and the rocks examined. The caliche exhibited a reddish-brown color on the outer surface (unburned control pieces were white) while the inner core was a light to medium gray. Though friable prior to firing, the caliche broke down even more after baking. The various rock types (granite, rhyolite, limestone, and quartzite) exhibited some discoloration on the outer surface, ranging from a sooty black to gray color. Records were not kept on the number of spalls present prior to firing, but an effort was made to place whole, unbroken pieces in the pit. After

cooling, only a few pieces were fractured and no pieces were broken.

The results of this experiment, though very informal, are interesting in light of past experiments conducted by Duncan and Doleman (1991). In similar baking experiments, they note that caliche was slightly discolored on the outer surface, fractured, and "the interior turned a dull light gray" (Duncan and Doleman 1991: 319). Other rock types tested (limestone and granite or monzonite) exhibited discoloration on the outer surface and little or no fracturing. They also conducted experiments with stone boiling and found that both caliche and rock became heavily fractured and broke in distinctive patterns. They also note that monzonite rock (granite) was more thermally efficient than other materials. Through their analysis of archaeological material excavated during testing, Duncan and Doleman (1991) conclude that at least some burned rock may have been used in stone boiling, as well as for hearth rock.

In light of these generalizations, patterns noted for the Tobin Well burned rock make more sense. The large quantity of burned rock and its fractured state may point to the use of stone boiling at some features within the project area. The large quantity of caliche, though not as effective for stone boiling, may have been utilized for pit baking (see Duncan and Doleman 1991). Though the Tobin Well analysis of burned rock was not as intensive as Duncan and Doleman's, the general patterns are similar to their results.

Special Analyses

This section presents data, analyses and results from radiocarbon, obsidian hydration, macrobotanical, and faunal studies. The goal of this section is to isolate chronological and subsistence-related patterns as they relate to prehistoric features discovered during the Tobin Well testing. An analysis of artifact size as related to geomorphic context examines any pattern that might affect the archaeological record. An analysis of regional pit structures undertook to determine if any patterns in architectural variability were present.

Radiocarbon

Large quantities of feature sediments were collected and subjected to flotation to recover sufficient quantities of charcoal for radiocarbon dating. The samples were dried, cleaned, weighed, and packaged in aluminum foil before being submitted to Beta Analytic, Inc., Coral Gables, Florida, for processing. Several features produced no datable charcoal, and others produced more than enough for dating. Features 36 and 39 were dated by accelerated mass spectrometry and others were subjected to extended counting. All samples were corrected for differences in carbon fractionation and tree-ring calibrated using the CALIB 3.0.3 program (Stuiver and Reimer 1993).

Nineteen radiocarbon dates from 14 features indicate occupation of the project area from the late Archaic through the late Formative period (Table 8.7). Twenty-six percent of the dates fall within the late Archaic period, 26% within the early Formative period, and 47% within the late Formative period. The dates indicate an apparent increase in the use of the project area during

Table 8.7. Radiocarbon Dates for Features.

Site #	Fea. #	Type	Date (B.P.)	Date (B.C.–A.D.)
41EP4717	24	Hearth	1830 ± 80	A.D. 87–324
41EP4719	25	Midden	1040 ± 100	A.D. 893–1153
41EP4719	25	Midden	830 ± 80	A.D. 1162–1282
41EP4719	26	Midden	860 ± 80	A.D. 1046–1276
41EP4719	26	Midden	830 ± 80	A.D. 1162–1282
41EP4719	27	Hearth in Fea. 26	690 ± 60	A.D. 1281–1386
41EP4719	28	Structure	860 ± 80	A.D. 1046–1276
41EP4722	32	Structure	780 ± 70	A.D. 1217–1290
41EP4722	32	Structure	680 ± 70	A.D. 1281–1393
41EP4722	33	Hearth in Fea. 32	860 ± 90	A.D. 1041–1278
41EP4731	36	Hearth	1470 ± 60	A.D. 547–651
41EP4731	37	Hearth	1260 ± 70	A.D. 675–881
41EP4731	38	Hearth	2210 ± 80	381–164 B.C.
41EP4731	38	Hearth	2250 ± 80	393–192 B.C.
41EP4731	39	Hearth	2520 ± 60	793–525 B.C.
41EP4731	42	Hearth	1270 ± 70	A.D. 671–873
41EP4734	42	Hearth	1250 ± 80	A.D. 675–886
41EP4735	43	Hearth	2030 ± 70	103 B.C.–67 A.D.
41EP4735	44	Pit	510 ± 90	A.D. 1327–1454

the late Formative period. The pattern coincides with Whalen's (1978) concept of more intensive use of the Hueco Bolson during the late Mesilla and early El Paso phases.

Comparison of feature types through time to discern any evident patterns shows that hearths dominate during the earlier time periods, and feature diversity increases in later time periods (Figure 8.2). In some instances, dates from one site overlap enough to suggest that the features within a site (for example, 41EP4719) possibly were used concurrently. However, in other cases, dated features within a site (for example, 41EP4731) do not overlap. Dates from the four excavated features on 41EP4731 show two distinct occupational episodes, one during the late Archaic period and one during the early Formative period. More than 10 meters separates these features spatially. It appears that the later occupation of 41EP4731 was in a different area than the previous occupation. Further spatial pattern analysis based on radiocarbon analysis was not possible because of the small number of dates for the Tobin Well project.

Obsidian Hydration

Dr. Christopher Stevenson of Archaeological Services Consultants of Columbus, Ohio, analyzed 19 pieces of obsidian using obsidian hydration procedures. The dating method uses the measurement of the intrinsic water content absorbed by the obsidian hydration rim. Intrinsic water content is based on a regression equation that correlates specific density to water content. The standard Arrhenius equation for exponential diffusion processes determines the arc rate, which is calibrated by relative humidity and effective high temperature to determine the age before present. Relative humidity was set at a constant 90%. More information concerning obsidian hydration procedures and methods is available in Miller (n.d.).

The results of the obsidian dating analysis were disappointing. Of the nineteen pieces submitted, only fifteen could be dated. Unfortunately, only two sites from the obsidian dating analyses have comparable radiocarbon dates, and only two dates correlate with radiocarbon dates (41EP4719, Feature 25). The other thirteen dates range in age from 3184 B.C. to A.D. 1687 (Table 8.8).

In general, the results of the analyses are dubious. Miller (n.d.) demonstrates that variation in relative humidity used in the dating equation affects the outcome of the

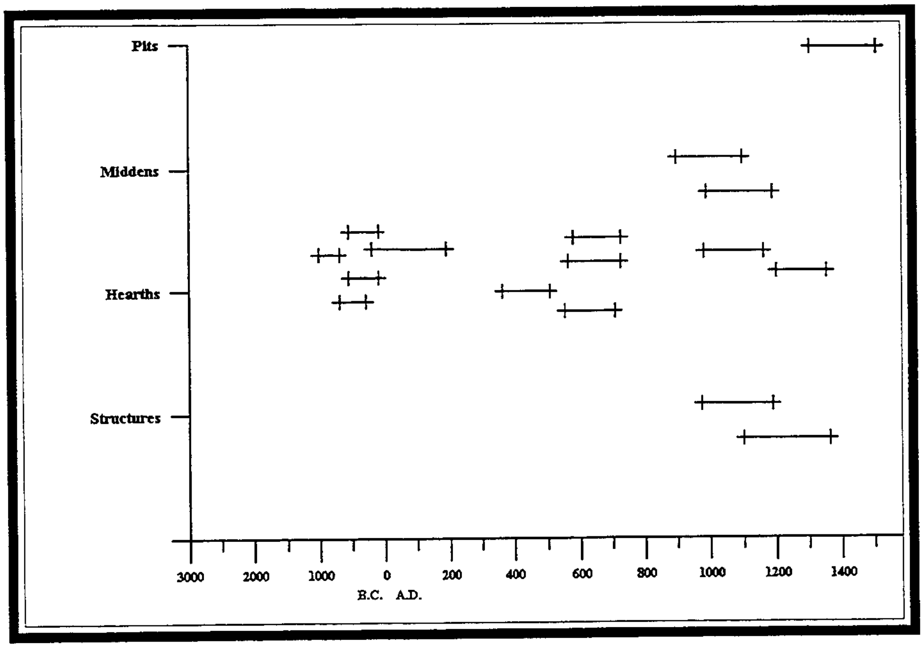

Figure 8.2. Temporal Periods of Feature Types. Multiple dates for single features are averaged.

Table 8.8. Obsidian Dates for Artifacts.*

Site #	Fea. #	Artifact	Date
41EP4711	–	Flake	A.D. 712
41EP4713	–	Flake	A.D. 719
41EP4713	–	Flake	A.D. 1585
41EP4713	–	Core	–
41EP4713	–	Flake	A.D. 452
41EP4713	–	Flake	–
41EP4713	–	Flake	A.D. 736
41EP4715	–	Flake	3184 B.C.
41EP4717	–	Flake	A.D. 514
41EP4718	25	Flake	A.D. 1189
41EP4719	–	Debitage	A.D. 1027
41EP4719	25	Flake	–
41EP4719	25	Flake	A.D. 1245
41EP4719	25	Flake	A.D. 1489
41EP4719	28	Debitage	A.D. 1687
41EP4723	–	Flake	–
41EP4728	–	Flake	85 B.C.
41EP4738	–	Tested pebble	A.D. 1461
41EP4738	–	Flake	A.D. 473

* Relative humidity set at 90%.

dating results. Because relative humidity varies with depth (more deeply buried pieces are subject to higher humidity), corrections are necessary to determine the proper target date. To show this variation, Miles Miller, an archaeologist working at Fort Bliss, conducted two analyses to test various absolute and relative dating methods. The first experiment used a variable relative humidity set between 30% and 100% for all obsidian pieces and the second used a constant relative humidity set at 90%.

The results of these two analyses indicate highly variable date results (Tables 8.9 and 8.10). The first run dates (Table 8.9) with variable humidity rates are drastically different from the second run dates (Table 8.10) where the humidity was set at a constant 90% for all samples. This difference is especially notable for the extremely early date on site 41EP4715. The first run date on this site is 13,156 B.C. with the relative

Table 8.9. Obsidian Data Using Variable Relative Humidity.

Site#	Depth (cm)	OH (%)	EHT	RH	A	E	ARC Rate	RH Rate	Rim Width	Date B.P.	Cal. Date
41EP4711	0	0.33	295.75	0.30	2.97	80887.80	31.79	8.30	5.50	3643	1693 B.C.
41EP4713	0	0.28	295.74	0.30	2.61	81605.53	25.52	6.67	4.88	3572	1622 B.C.
41EP4713	0	0.20	295.74	0.30	2.07	82802.68	17.34	4.53	4.05	3621	1671 B.C.
41EP4713	0	0.26	295.74	0.30	2.47	81915.39	23.15	6.05	2.55	1075	A.D. 875
41EP4713	0	0.25	295.74	0.30	2.43	81992.74	22.59	5.90	5.10	4408	2458 B.C.
41EP4713	0	0.16	295.74	0.30	1.68	83761.51	12.46	3.25	–	–	–
41EP4713	0	0.19	295.74	0.30	1.98	83020.59	16.12	4.21	–	–	–
41EP4715	0	0.10	295.74	0.30	1.06	85574.00	6.21	1.62	4.95	15106	13156 B.C.
41EP4717	27	0.16	294.71	0.90	1.71	83703.14	11.29	8.68	3.53	1436	A.D. 514
41EP4719	40	0.26	294.71	1.00	2.52	81812.13	21.29	21.29	3.53	585	A.D. 1365
41EP4719	65	0.32	294.71	1.00	2.88	81065.87	26.85	26.85	2.33	202	A.D. 1748
41EP4719	30	0.34	294.71	0.90	3.02	80786.61	29.22	22.45	3.98	705	A.D. 1245
41EP4719	30	0.29	294.71	0.90	2.71	81399.23	24.23	18.63	2.93	461	A.D. 1489
41EP4719	30	0.34	294.71	0.90	2.98	80862.46	28.56	21.95	4.50	926	A.D. 1027
41EP4723	15	0.13	295.51	0.60	1.42	84476.52	9.33	3.04	–	–	–
41EP4728	30	0.25	294.71	0.90	2.44	81966.97	20.27	15.58	5.63	2035	85 B.C.
41EP4738	0	0.24	295.74	0.30	2.33	82224.00	20.97	5.48	4.88	4347	2397 B.C.
41EP4738	0	0.20	295.74	0.30	2.00	82972.74	16.38	4.28	2.48	1437	A.D. 513

humidity set at 30%, and the second run date is 3184 B.C. with the humidity set at 90%. Several other dates changed substantially, while others remained unchanged. The relative humidity variable appears to introduce a substantial amount of variation into the dating determination. Increasing the relative humidity from 30 and 60% to 90% nearly halved some dates. It appears that obsidian hydration measured by intrinsic water content and using relative humidity correction contains substantial variability in the results obtained.

Discussion

The outcome of the radiocarbon and obsidian dating analyses for the Tobin Well project resulted in few recognizable patterns, primarily because of the low number of samples for both analyses. The radiocarbon dates indicate a peak use of the project area between A.D. 900 and 1400. No gross spatial pattern was evident because of the small area examined by the project. Some sites, however, contain distinctly different occupational periods. Site 41EP4731, for example, contains late Archaic period and middle to late Mesilla phase components within approximately 10 meters. Thus, it can be said that some sites have the potential for long occupational histories within a spatially bounded area. This makes the site more difficult to interpret in an analytic sense. Mauldin (1993b) documents the same pattern for some of the small sites dated in the Hueco Bolson. Perhaps, as Mauldin suggests, the feature and its surrounding area is a more appropriate unit of analysis when attempting to assess temporal affiliation of sites in the Hueco Bolson.

Table 8.10. Obsidian Data Using Constant Relative Humidity.

Site #	Depth	OH %	EHT	RH	A	E	ARC Rate	RH Rate	Rim Width	BP	Cal Date
41EP4711	0	0.33	295.74	0.90	2.97	80887.80	31.79	24.43	5.50	1238	A.D. 712
41EP4713	0	0.16	295.74	0.90	1.68	83761.51	12.46	9.57	0	0	–
41EP4713	0	0.25	295.74	0.90	2.43	81992.74	22.59	17.36	5.10	1498	A.D. 452
41EP4713	0	0.20	295.74	0.90	2.07	82802.68	17.34	13.33	4.05	1231	A.D. 719
41EP4713	0	0.26	295.74	0.90	2.47	81915.39	23.15	17.79	2.55	365	A.D. 1585
41EP4713	0	0.28	295.74	0.90	2.61	81605.53	25.52	19.61	4.88	1214	A.D. 736
41EP4713	0	0.19	295.74	0.90	1.98	83020.59	16.12	12.39	0	0	–
41EP4715	0	0.10	295.74	0.90	1.06	85574.00	6.21	4.77	4.95	5134	3184 B.C.
41EP4717	27	0.16	294.71	0.90	1.71	83703.14	11.29	8.68	3.53	1436	A.D. 514
41EP4719	40	0.32	294.71	0.90	2.88	81065.87	26.85	20.64	2.33	263	A.D. 1687
41EP4719	65	0.26	294.71	0.90	2.52	81812.13	21.29	16.37	3.53	761	A.D. 1189
41EP4719	30	0.34	294.71	0.90	3.02	80786.61	29.22	22.45	3.98	705	A.D. 1245
41EP4719	30	0.29	294.71	0.90	2.71	81399.23	24.23	18.63	2.93	461	A.D. 1489
41EP4719	30	0.34	294.71	0.90	2.98	80862.46	28.56	21.95	4.50	923	A.D. 1027
41EP4723	15	0.13	295.51	0.90	1.42	84476.52	9.33	7.17	0	0	–
41EP4728	30	0.25	294.71	0.90	2.44	81966.97	20.27	15.58	5.63	2035	85 B.C.
41EP4738	0	0.20	295.74	0.90	2.00	82972.74	16.38	12.59	2.48	489	A.D. 1461
41EP4738	0	0.24	295.74	0.90	2.33	82224.00	20.97	16.12	4.88	1477	A.D. 473

Obsidian hydration analysis results were disappointing. Only two of the seven sites with obsidian had comparable radiocarbon dates. The dates appear to show increasing use of obsidian in later time periods. The use of relative humidity correction rates apparently skew many of the dates when different rates are used. Because of this it appears that obsidian hydration dating method is too variable to be of utility in reliably dating obsidian artifacts, let alone archaeological sites.

Subsistence Analyses

Two types of analyses were conducted to determine the types of food consumed by the prehistoric inhabitants of the project area. These included macrobotanical analyses of excavated hearth, midden, and pit structure material and minifaunal analysis of recovered bone.

Macrobotanical Studies

Macrobotanical remains recovered from the Tobin Well project are from pit structures, hearths, and middens. Dr. Richard Holloway of Quaternary Services analyzed 16 samples (Appendix C). Prior to submission, all samples were separated by flotation and dried. Samples were cleaned of all large twigs, sticks, and rocks, and each was measured in a small beaker to determine its volume. Samples were bagged in plastic. Analysis consisted of volume measurements to determine sample size followed by examination under a stereoscopic microscope (7x–45x magnification). Some

samples were screened again to consolidate materials. A reference collection was used for comparison of recovered samples. Unfortunately, no charred seeds or identifiable plant parts were recovered from any of the samples submitted for analysis. Dr. Holloway stated that this was not surprising because most of the charred material was removed for radiocarbon analysis prior to sample submission. Future macrobotanical studies should be conducted either before radiocarbon analysis (samples are returned for curatorship) or care should be exercised in the removal of charred material for radiocarbon dating (that is, pick out only large pieces of wood). In either case, care must be taken with the samples if any results are to be obtained.

Faunal Studies

The Tobin Well Project recovered a total of 147 pieces of bone; 136 of these were associated with features. The condition of the recovered bone was fragmentary and severely eroded, which made positive identification of species impossible; therefore, no specialist analysis was performed. Instead, bones were classified as either burned or unburned and identified either as avian or mammal. This minianalysis met with some limited success. However, due to the small sample size and the fact that 69.3% of the faunal assemblage came from one feature (Feature 25 midden), little can be said about the distribution of faunal material across the project.

Identified bones include avian ($N = 32$; 21.7%) and mammal ($N = 11$; 7.5%). All pieces are fragmentary and most exhibit signs of burning. The mammal bones are all small, probably rodent. These may have been hunted and consumed or, more likely, are intrusive to the features. It would appear that birds were preferred over mammals although this is almost certainly not the case given the small sample size and fragmentary nature of the assemblage. Whalen (1978) and other archaeologists working in the region note that mammal bones such as rabbit and deer are more prevalent.

Other Special Analyses

Artifact Size

To examine the possibility that geomorphological factors may influence the record that archaeologists observe, a study of artifact size between surface and subsurface contexts was conducted. The goal was to isolate patterns that might bias observations made between these two contexts.

Mean artifact size was tabulated for surface and subsurface ceramic sherds and lithics (Table 8.11). Hearth rock was examined (Table 8.12) by size categories because no data on length and width were available. Ceramic sherds from the surface appear slightly larger than those from below the surface. Lithics follow this same pattern, but the difference in size is much more pronounced. In general, hearth rocks follow a similar pattern. The sizes for surface hearth rocks are larger than those from the subsurface.

Table 8.11. Surface and Subsurface Artifact Sizes.

Context	Mean Length (cm)	Mean Width (cm)
Surface ceramics	26.99	19.91
Subsurface ceramics	25.12	18.59
Surface lithics	22.77	17.99
Subsurface lithics	16.04	14.00

Table 8.12. Surface and Subsurface Hearth Rock Sizes.

Size (cm)	Surface	Subsurface
1	14	121
2	38	43
3	107	45
4	101	24
5	73	27
6	50	9
7	45	11
8	20	8
9	22	4
10	9	4
11	2	0
12	3	4
13	0	6
14	0	1
16	0	1
17	0	2

Other researchers (Seaman and Doleman 1988; Doleman and Chapman 1990; Mauldin 1993b) document similar patterns of size sorting. The implication of this size sorting action indicates that archaeological context has changed throughout much of the project area, as well as in the Hueco Bolson and Tularosa Basin. Thus, no archaeological context, surface or subsurface, is pristine—some sort of geomorphological process has acted upon the archaeological record altering both the vertical and horizontal positions. This small analysis demonstrates that size sorting affects the archaeological record examined during the Tobin Well Project.

Regional Pit Structures

Prehistoric architecture in the Southwest has long been of interest to archaeologists. The ruins of Casas Grandes in north-central Mexico, the Casa Grande ruins of southern Arizona, the spectacular ruins of Chaco Canyon, and the cliff dwellings at Mesa Verde all provide examples of past prehistoric architecture. Architecture such as this, however, is large-scale, monumental, and limited to a small time period (usually post-A.D. 900); it is not likely to provide all the answers to the development and variability of architecture for past prehistoric systems, especially early hunter-gatherer systems of south-central and southeastern New Mexico. This area is traditionally known as the Jornada (Desert or Lowland) Mogollon culture area. Much of this area is known from large-scale survey and intermittent testing and excavation. In comparison to the Western Mogollon and Anasazi regions, only a general picture of the prehistoric settlement, subsistence and technological systems has emerged (Whalen 1977, 1978, 1980, 1994; O'Laughlin 1980; Carmichael 1986; Mauldin 1993b). One aspect of Jornada Mogollon material culture that has received little research is architecture. Nearly 300 pit structures have been tested or excavated within this region and the majority have associated radiocarbon dates. However, research into variability of pit structures within the Jornada Mogollon region is almost nonexistent, though descriptions of the various types of structures abound (Lehmer 1948; Aten 1972; Whalen 1977, 1978, 1980; O'Laughlin 1980, 1989; Kegley 1982; Hard 1983b; Carmichael 1985; Scarborough 1986; Miller 1989). Carmichael (1986) offers the only summary of pit structures in the region, but he offers no interpretations of the differences and similarities of these structures. Thus, an analysis of pit structures has the potential to provide needed baseline on pit structure variability in the region as well as provide an outline of architectural change through time.

Architectural form can inform archaeologists about aspects of social and technological behavior and contribute to the larger database on southwestern architecture. Because of the large sample of pit structures available and their associated dates, the Tobin Well Project examined quantitative (for example, area, depth), as well as qualitative variables (for example, shape) in an attempt to document morphological and temporal patterns.

Early investigators (Haury 1940; Martin and Rinaldo 1950; Schroeder and Wendorf 1954) saw architectural forms as style markers equated with different cultural groups. An example of this is the belief that because the Anasazi constructed aboveground dwellings before the Mogollon, the aboveground structures built by the Mogollon were the result of an Anasazi migration.

Later investigators (Hill 1970; DeGarmo 1975; Farwell 1981; Reid and Whittlesey 1982) saw structural variability as an adaptation to certain natural and social environments. Examples include pit structures being more thermally efficient in cold weather (Farwell 1981) and larger rooms correlated with increased altitude (Nelson 1981). Social examples include the reconstruction of households based on room size, assemblage content, features, and construction techniques. The implicit assumption behind these studies is that architecture reflects social organization. Unfortunately, recognizing different types of social order through architecture is ambiguous at best and inferences drawn from architectural patterns are tenuous.

More theoretically oriented research involves isolating variables and processes that may account for changes in architectural forms (Rapoport 1969; Plog 1974; Hunter-Anderson 1977; Lipe and Breternitz 1980; Braun and Plog 1982; McGuire and Schiffer 1983). Rapoport (1969) provides one of the first theoretical treatments of house form. He examines environmental, social, and technological variables that he suggests are crucial to understanding the development of house forms. Plog (1974) looks at population, differences in activities, subsistence, and social factors to posit changes that occurred in storage facilities and room function. Hunter-Anderson (1977) attempts to isolate specific variables that could account for house form change. Her study is one of the few to try and look at why these changes occurred. She suggests that as role-related activities, diversity of functions, and volume of materials increased, house form tended to become more square. Thus, increasing activities within homes should lead to increasingly square shapes and decreasing activities should lead to more round shapes. Finally, Lipe and Breternitz (1980) look at the pithouse-to-pueblo transition in the Dolores, Colorado, area in an attempt to identify variables within a systemic context that could account for the transition.

Gilman (1983: 2), using data collected from Black Mesa, constructs a theoretical framework based on the assumption that "structure forms and the relationship among structures, features, and activity areas (site structures) will change in response to variations in the natural and social conditions surrounding these forms." Such a framework is based on a site structural approach and attempts to ascertain how the organizational properties of a cultural system change through time. Gilman uses ethnographic and archaeological evidence to provide support for her theory. She examines a number of

variables, including population size and environment, to isolate those variables that are the most critical to architectural change. Gilman found, using the Black Mesa data from various time periods, that the relationship between the identified variables was useful in assessing the change from pithouses to pueblos, as well as in explaining architecture changes in general. According to Gilman (1983: 255–256), if population and subsistence increase, changes occur in settlement pattern, storage, and food production areas. Environment, as a more unpredictable variable, also causes changes in food reliability and location.

Kent (1990), in a cross-cultural ethnographic study of architecture, proposes a model that sociopolitical complexity determines the organization of space and the complexity of architecture. Further, as sociopolitical complexity increases, the segmentation of organized space also increases. The results of Kent's analysis indicate that the aspects of the model tested appear to hold true—increasingly complex societies show marked increases in the organization of space, architectural complexity, and the segmentation of space. Along similar lines, Binford (1990) examined variability among a large sample of ethnographic groups. The focus of this research was on housing and its relation to mobility and subsistence. Binford (1990: 121–130) notes several patterns from the data:

- Groups that have high mobility primarily have circular to semicircular house, while groups that are more sedentary have rectangular and square shapes.
- Groups that are more mobile generally construct houses directly on the ground surface, while sedentary groups invest more effort in constructing houses dug into the earth.
- Groups that exhibit midrange mobility and sedentism generally have alternative house forms (that is, shades, shelters, huts). Groups that exhibit very high or very low mobility generally do not use alternative house forms.

Binford also notes that these patterns relate to environmental differences among the various groups and that dependence on certain resources (hunting versus gathering) also varies according to environment. For the purposes of this study, the above patterns are the most important. Further details can be found in Binford (1990).

Research indicates that architectural change is important to understanding past cultural systems. Research focus has changed from speculation on architectural variability to more informed and theoretical avenues on how and why architecture varies. It appears that from this research, as well as the archaeological and ethnographic data, that morphological characteristics of architecture and settlement location are useful in making generalizations about past prehistoric cultural systems. This analysis does not attempt to answer the question of how or why architectural forms changed in the Jornada Mogollon region, but will focus on the changes in morphological variables through time in an attempt to isolate patterns that may give archaeologists clues to the how and why questions. Based on the outlined theoretical and ethnographic data, three simple research hypotheses were posed:

1. In general, more mobile, forager-based systems should exhibit archi-

tecture that is round in shape and shows no extensive evidence of significant energy investment for construction. In contrast, less mobile, collector-based systems should exhibit architecture that is square in shape and shows evidence of significant energy investment in construction (that is, collared hearths, prepared floors, plaster, or partitions).

2. Variables such as size and depth should increase through time. Pit structures in later time periods should be larger and deeper, possibly reflecting a change in mobility. Shape should also change from round structures in early time periods to square structures in later time periods.

3. Pit structures in the Jornada Mogollon region should be in all topographic areas during early time periods, and later time periods should have pit structures in more restricted topographic settings (for example, the alluvial fans).

A database of variables such as structure size, depth, shape, location, and date (if any), as well as associated features, was assembled for pit structures located throughout the region. Data was gathered primarily from published sources, though some unpublished data has been included. From this data, 48 excavated structures that have radiometric dates were selected. Most of the structures are radiocarbon dated, some with as many as three dates that were averaged to arrive at a mean date. One structure has a thermoluminescence date, four have archaeomagnetic dates, and one has an obsidian hydration date. None of the dates are tree-ring calibrated due to inconsistent reporting in dates before present for the projects from which the structure samples are drawn. Median dates were calculated for the 48 structures, and bivariate plots were run to contrast the variables from the database. The variables examined in this analysis are pit structure size measured in square meters, structure depth measured in centimeters, structure shape (usually either round or square), and structure location (basin, alluvial fan, or river).

The first data plots for this analysis compare size variables, shape, and depth. Most structures are between 2 and 11 square meters in size and range in depth from 10 to 45 centimeters (Figure 8.3). No correlation is noted between increasing size and depth. Some structures are very large, but shallow, while others are small but very deep. Most of the sample structures are round and between 5 and 40 centimeters deep (Figure 8.4). In general, it appears that the square structures are deeper than their round counterparts and square structures are larger in floor area than round ones. Geomorphic factors, however, could affect this relationship. Comparison of shape and size indicates that round structures measure between 2 and 10 square meters, whereas square structures range from 4 to 20 square meters (Figure 8.5). Not surprisingly, the square structures are larger in floor area than round ones, but the range of variability in square structure size is larger. In general, these data indicate that structure size does not appear to be correlated with depth, but that shape does appear to be weakly correlated with both depth and size.

The relationship of the above variables to temporal periods reveals some interesting patterns:

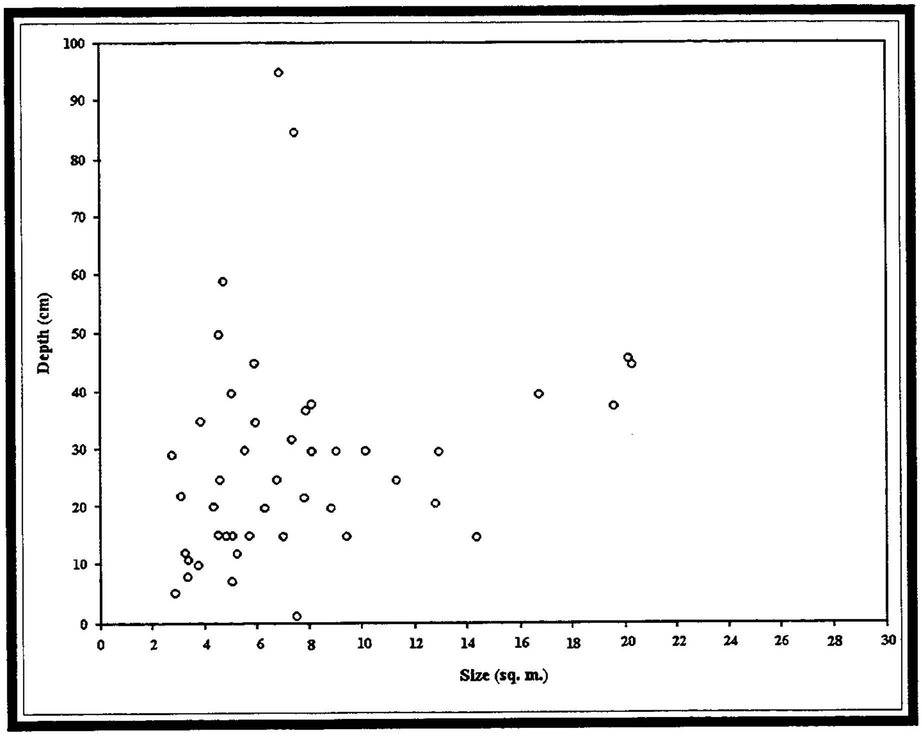

Figure 8.3. Pit Structures Depth Versus Size.

- Structure size appears to increase through time, with the largest structures appearing around A.D. 1200 (Figure 8.6).
- A weak trend of increasing depth can be seen through time with a peak around A.D. 1200 (Figure 8.7).
- Round structures appear through most time periods until A.D. 1200; square structures first appear around A.D. 500 and increase in frequency until A.D. 1200 (Figure 8.8).
- More structures are common in basin contexts from circa 1000 B.C. to A.D. 1200. There is, however, a definite increase in the use of the alluvial fans from about A.D. 400 until after A.D. 1200 (Figure 8.9).
- Round structures are more common in basin settings and square structures are more common in alluvial fan settings.

The data appear to indicate increasing structure size and depth through time. Structure shape shows the strongest and most interesting pattern, indicating that round structures are common through most time periods, but that square structures first appear around A.D. 500 and increase in number until A.D. 1200. The square shape also appears to correlate with different environmental zones more than the round structures. A larger sample of radiocarbon dated structures would further aid in defining the general trends noted in this preliminary analysis of pit structure variability.

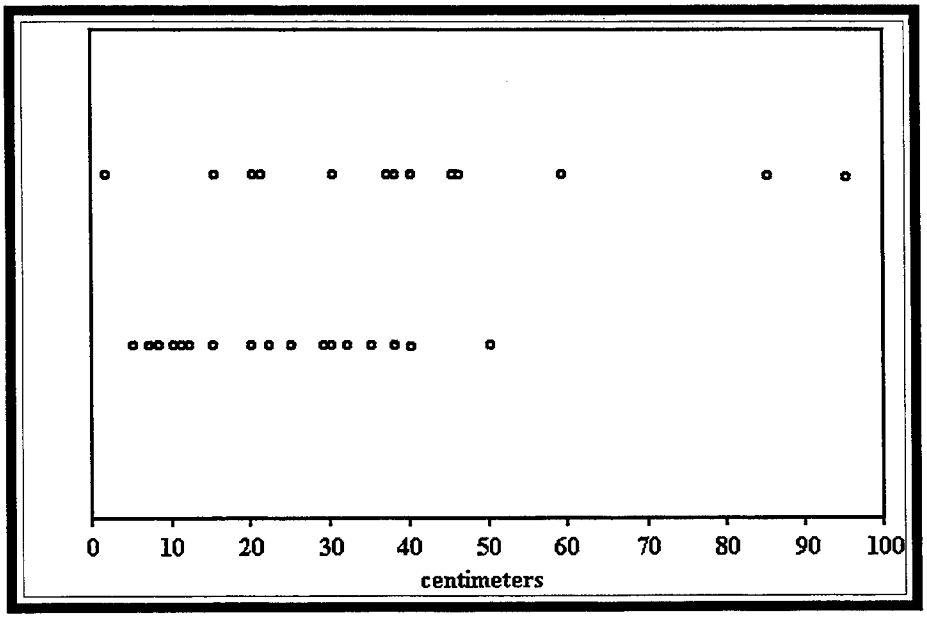

Figure 8.4. Pit Structure Shape Versus Depth.

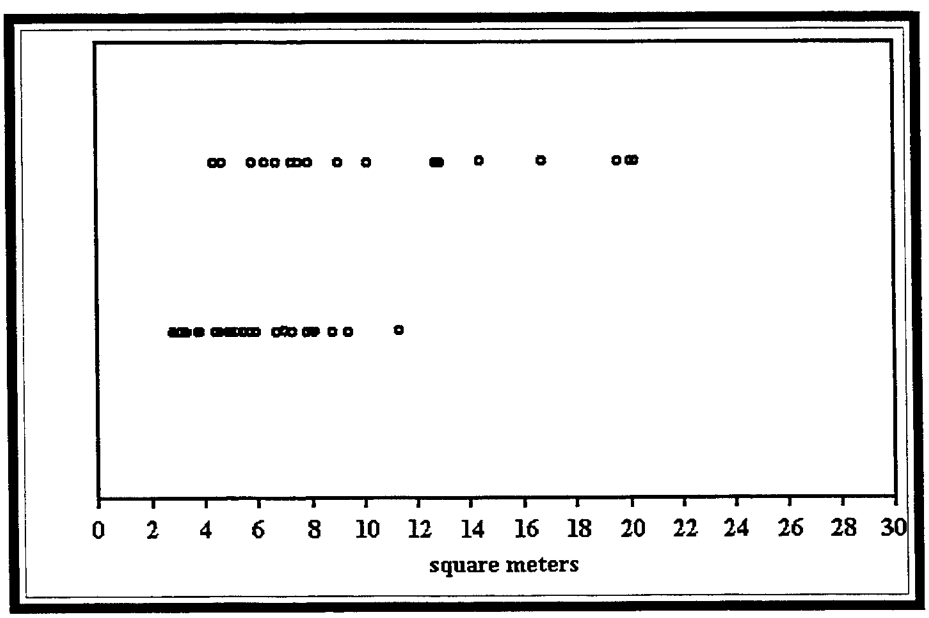

Figure 8.5. Pit Structure Shape Versus Size.

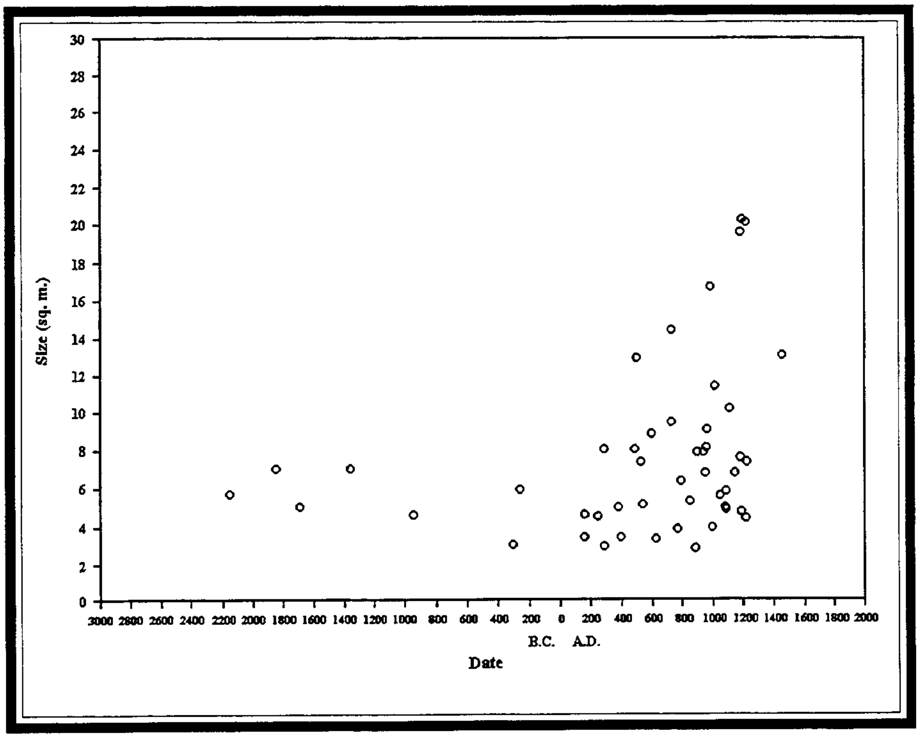

Figure 8.6. Pit Structure Size by Temporal Period.

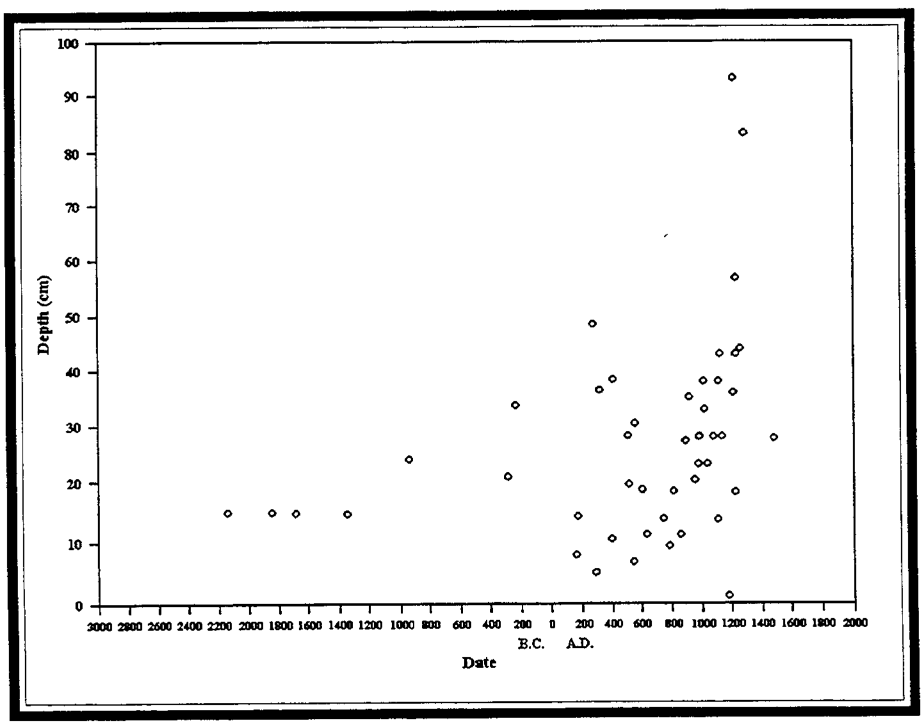

Figure 8.7. Pit Structure Depth by Temporal Period.

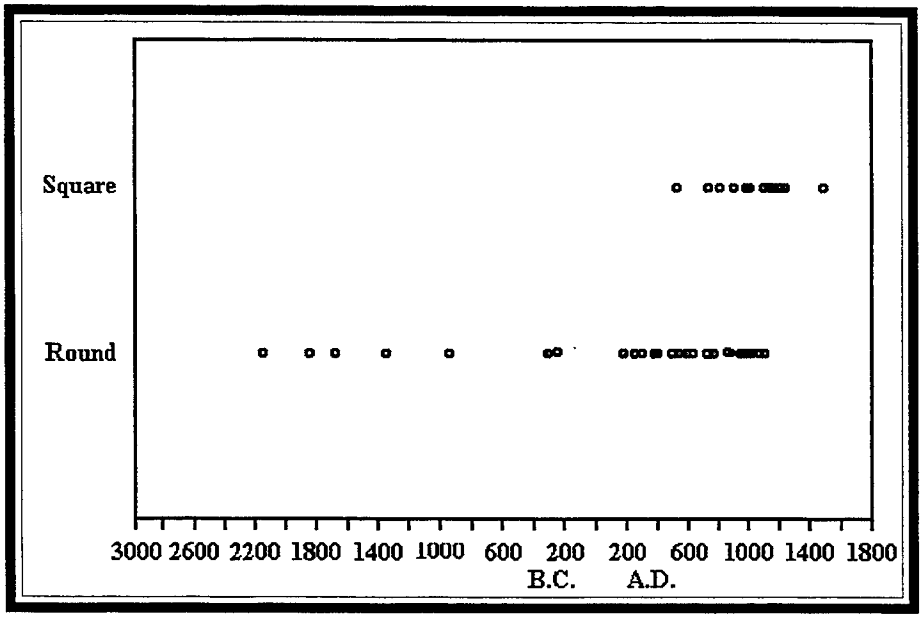

Figure 8.8. Pit Structure Shape by Temporal Period.

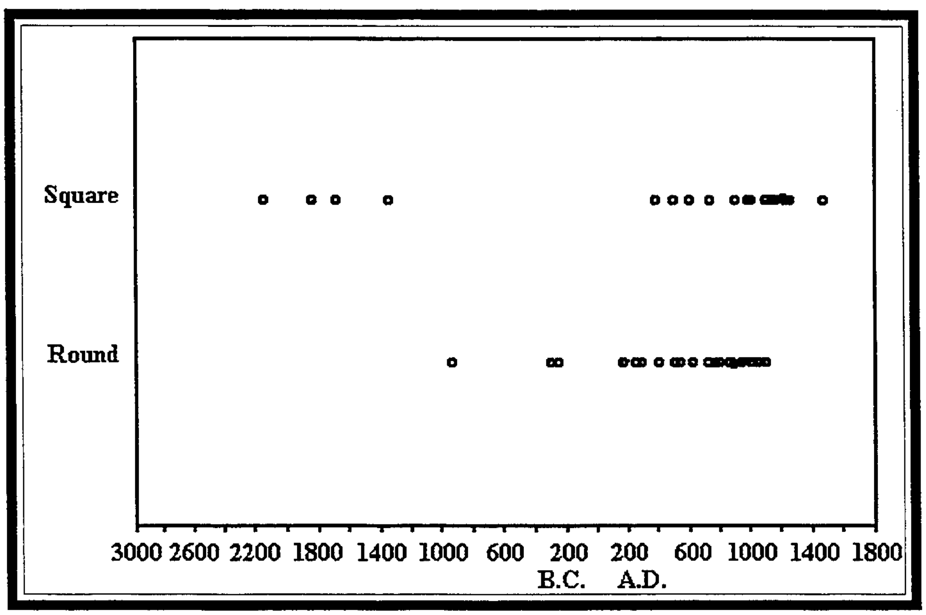

Figure 8.9. Pit Structure Location by Temporal Period.

What do these comparisons mean in terms of the hypotheses posed earlier? First, the data appear to indicate a change in the use of structures throughout the Jornada Mogollon region. Small, shallow, round structures appear to be the most common type of architecture for all time periods. Studies show that this type of structure is common among small groups of mobile hunter-gatherers, whereas square structures correlate with more sedentary, agricultural groups (Robbins 1966; Whiting and Ayres 1968; Flannery 1972). Some time after A.D. 500 large, deep, square-shaped structures made their first appearance in the region and continued to increase in frequency until about A.D. 1100 to 1200 when the first pueblos appeared. However, round structures were in use concurrently with the square types. The results, then, appear to support Hypothesis 1. Though this analysis did not examine feature variation, square structures for this region show increased investment in facilities such as collared hearths, plaster, and formal post plans.

Hypothesis 2 proposed that pit structure size, depth, and shape should increase in later time periods. The results indicate a correlation of increasing size, but less reliable results for increasing depth through time. Analysis of shape indicates that round structures occur throughout the temporal sequence, while square shapes are restricted to later time periods.

The last hypothesis proposed that structure location should change through time. Again the results appear to support this, though the overall correlation is weak. Structures are found in all environmental zones in early time periods, but become more restricted in later periods; this is especially true for square structures.

Studies of changing architecture in the Anasazi region (McKenna and Truell 1986) document similar changes in form during the same time periods, though the structures are much more formal and change much more rapidly than the El Paso counterparts. Data from the comparison of pit structures may indicate (1) a shift in subsistence adaptation for the Jornada Mogollon, or (2) a new and culturally distinct group moved into the area around A.D. 500 and coexisted with the current hunter-gatherer group (Upham et al. 1984). Of these two hypotheses, the former seems more plausible—the seasonal forager strategy changed to a seasonal forager-collector strategy. Square structures represent the more sedentary aspect of the adaptation and may reflect increasing dependence on cultivated crops harvested in the late summer and early fall. Square structures are primarily on distal alluvial fans suited for agriculture because of available water in nearby playas and the central location for exploiting resources from the mountains and the basin. Square structures have increased amounts of space and are more formally constructed, indicating that people probably stayed in these areas for longer periods. The round structures represent the more mobile aspect of the adaptation and may indicate that at other times of the year people moved about in smaller groups exploiting resources as they were available. Because water is available only in quantity in rain-filled playas—usually in the summer—or the river, mobility would have been high during the times of the year that water was scarce. The choices would have been to live near the river for the balance of the year or to move frequently to known water sources throughout the region.

Another possibility is that people lived on the alluvial fans for most of the year and left the village temporarily to hunt and gather resources. Camps set up for this activity would include the round structures and several hearth areas. Because these sites were temporary, round brush structures would have been ideal. Living near the river for the balance of the year would have been impractical because resources would quickly have become exhausted. This is not to say that people did not live near the river at times of the year, certainly they did. However, living near the river for several months of the year entailed logistical problems of a different sort. If the river was another sedentary location, more formal structures would be expected at this location as well. Though much of the above is speculation, this analysis demonstrates that architectural variability exists within the Jornada Mogollon region and that this variability shows definite temporal trends.

Summary

Subsurface testing within the Tobin Well Project area recovered several thousand artifacts and excavated 279 1-meter-square units, removing a total of 74.9 square meters of fill. Eighteen features were discovered during the Tobin Well testing phase; of the eighteen, 14 were dated by radiocarbon analysis. A series of analyses that compared various data sets (artifacts, burned caliche, fire-cracked rock, faunal remains) to feature types generally revealed no strong patterns for artifact-feature associations.

Intensive analysis of fire-cracked rock revealed that burned caliche was the most common rock type utilized for hearth features. Granite and quartzite were the next most common hearth materials. Size of associated rock was generally around 1 centimeter with most analyzed rock less than 6 centimeters in size. Hearth experiments by the primary author and other researchers (Duncan and Doleman 1991) indicated that stone boiling may account for much of the fractured nature of fire-altered rock.

Specialized analyses included chronological, subsistence, artifact size studies, and a study of regional pit structure variability. Nineteen pieces of obsidian subjected to obsidian hydration analysis found this method unreliable in dating artifacts, thus dating of sites in this fashion should be given great care. Results of analyses of macrobotanical remains and bone from hearths, middens, and pit structures were disappointing—samples contained no macrobotanical remains and faunal remains were so fragmentary that little could be said about prehistoric subsistence. Analysis of artifact size showed that size sorting of artifacts is an active process within the Tobin Well project area.

Analysis of regional pit structure variability indicated that size and depth of pit structures increased in the late Formative period. Further, more formal, deep, and square pit structures began to appear only after A.D. 500. Increasing feature type diversity was noted for later time periods.

9
DISCUSSION AND CONCLUSIONS

by

Chris Lowry

This chapter provides a summary of work completed during the Tobin Well project and discusses the implications of the findings in light of recent archaeological work in the region. The first of two sections outlines the results of survey, surface collection, and testing for the Tobin Well project and the subsequent results from analytical procedures carried out on the collected data. The results of these analyses are then evaluated in light of the theoretical expectations presented in Chapter 3 concerning the identification of site types. The second section presents a brief summary of recent work in hopes of gaining a better perspective about the organization of past cultural systems that inhabited the region.

Work and Analytical Results

The Tobin Well Project involved the survey, surface collection, and testing of 1.08 square kilometers for the U.S. Army's proposed Hawk Radar Expansion. The survey phase of the project discovered 48 archaeological sites. Survey data indicate the project area was inhabited from the late Archaic period to the late Formative period. Of the total project area, 109,229 square meters (9.4%) contained evidence of cultural remains. Testing of 16 sites removed 74.9 cubic meters of fill. The project encountered 44 surface and subsurface features and excavated 18. Fourteen of the features have radiocarbon dates. Several thousand surface and subsurface artifacts were collected and analyzed.

Analyses of survey data indicate that a significant portion of the surface archaeological record was not recorded. Factors accounting for this are crew spacing, visibility of cultural material, and crew experience. The unrecorded locations within the project area caused time and budgeting problems with the Phase II surface collection and testing program. Carmichael (1986), Seaman and Doleman (1988) and Mauldin (1993b) note similar problems.

Future surveys in this region should utilize smaller transect spacing and intensive recording of all cultural materials. Though time consuming, the increased effort will pay off with a more thorough knowledge of the surface archaeological record. Such knowledge will be important for settlement pattern and feature studies and provide a better database from which to determine significance criteria for Section 106 consultations.

Analyses of collected surface artifacts concentrated on defining the occupational history of the landscape and looking for differences in assemblage composition. Analyses of assemblage variation to determine occupational history were interesting. Strong patterns of various artifact types associated with fire-cracked rock were found. A weak pattern of tool artifact types versus waste artifact types was noted, and Tobin Well assemblage patterns are similar to patterns documented by Binford (1992). Assemblage composition analyses indicate a general pattern noted by Camilli et al (1988) of additive assemblages (continuously reused high density, high diversity locations not subject to intensive recycling) and subtractive assemblages (variable density, low diversity locations targeted for recycling, especially of ground stone artifacts).

The general ceramic analyses indicate a production change in later Formative times. Data on paste color, temper type, vessel part and vessel form support this hypothesis. Compositional analysis suggests that most local clays collected near the project area do not match collected sherds. Two (possibly three) distinct compositional groups within the collected ceramics are indicated. An examination of sherd clays versus sherd tempers shows no significant difference between clays and tempers. Reasons for this include the method used to separate clay from temper, insufficient temper to contaminate the clay matrix, and geologically similar clays and temper. The most important information to come from the compositional analysis is the identification of a compositional signature for El Paso brownwares. Such data can be compared with other compositional ceramic data from the region and will aid in identifying ceramic production locales.

Lithic analysis data suggest an overall late reduction sequence for the Tobin Well assemblage. The few formal tools and projectile points found during the project indicate probable intensive pot hunting and scale differences in the use of tools. A high ratio of utilized flakes to formal tools suggests that expedient flake technology was more common than formal tool use. One cause for this is reduced mobility in later Formative times. Overall smaller core size indicates conservation of cryptocrystalline materials, and use wear studies indicate a variety of activities. Ground stone analyses demonstrate a preference for local quartzites, extensive recycling as hearth rock, and small scale processing activities.

Phase II testing excavated 18 features. Most were small hearths ranging in age from the late Archaic to the late Formative period. Two middens and two structures were tested. Both date to the middle to late Formative period. Testing of middens from this period is rare and marks the first time such data has become available. Analyses revealed weak patterns between features and artifacts, especially the association of most artifacts with residential features such as middens and structures. Intensive analysis of fire-cracked rock and comparison to research conducted by Duncan and Doleman (1991) reveals that stone boiling may have been an important aspect of prehistoric subsistence in the area.

Special studies of chronology, subsistence, artifact size, and pit structures were also conducted. In general, features from later time periods are more diverse. Most features date to the late Formative period with a few in the late Archaic and early Formative periods. Obsidian hydration dates show considerable variability through time, but are questionable in their accuracy.

Macrobotanical studies were disappointing because the samples contained no seed remains. Surface artifacts are larger than those from the subsurface, indicating that geomorphological size-sorting processes have been acting upon the archaeological record of the project area and calling for caution when attempting to infer site function from surface assemblages.

Pit structures throughout the Jornada Mogollon region have significant variability, both morphologically and temporally. These patterns are most important as they are the strongest evidence for an adaptive shift occurring sometime after A.D. 500.

The primary analytical goal of the Tobin Well analyses was to identify organizational patterns within the archaeological assemblages to aid in defining site function areas or site types. This seemed like a goal that could be obtained with the data collected. However, problems with data collection and subsequent artifact analyses led to the conclusion that the research goal could not be entirely met.

Overall, analyses of the Tobin Well data advanced our understanding of the nature and character of the archaeological record within the region. Though individual site types could not be identified with as much precision as would be liked, general trends that hint of different site types were identified. The project area contains definite evidence of residential occupations (middens and structures) as well as more ephemeral occupations such as camps and foraging-logistical locations. All these occupational types within the project area appear to represent the overlay of several thousand years of intermittent human occupation. No sites that clearly represent a functional type of occupation were identified. The Tobin Well analyses were not fine grained enough to allow a more precise identification of site types, but other work within the region (Camilli et al 1988; Seaman et al. 1988; Anschuetz et al 1990; Doleman et al. 1991; Doleman et al. 1992; Mauldin 1993b) identifies patterns similar to (as well as different from) those observed at Tobin Well. Given the dynamic nature of the geomorphological environment in which the archaeological record for the region resides, it is not surprising that traditional ways of observing and classifying that record are inadequate for the task of understanding the nature of past cultural systems that inhabited the region. Once archaeologists begin to understand these dynamic processes and how they transformed the archaeological record, the quest for understanding the organizational qualities will be greatly aided.

In sum, the archaeological record examined during the Tobin Well project indicates an occupation from the late Archaic period through the late Formative period. Evidence shows that components from both forager and collector based systems are present, but the nature of these occupations and their distribution across space and through time is still being examined. Most cultural historical sequences posit a change from a general hunting and gathering system to one increasingly reliant upon agriculture (Lehmer 1948; Whalen 1977, 1978, 1980, 1994; Hard 1983a; Carmichael 1986; Mauldin 1986). Data from Tobin Well are not well suited for theorizing the development of the prehistoric system that did utilize this region; however, data analysis identified hints of these past systems. This research identified important patterns (that is, pit structure change, dated middens) con-

cerning the transitional period or Doña Ana phase. Whalen (1977, 1978) suggests that settlement patterns changed in the middle Formative period with residential sites being located in the transition zones (distal alluvial fans).

Other Regional Work

Though the goal of identifying site types could not be met with the Tobin Well data, several studies aid in understanding the organization of past cultural systems that utilized the landscapes within the region. Research initiated during the Borderstar 85 Survey (Seaman et al. 1988) continued during the multiphase research project, *Landscape Archaeology in the Southern Tularosa Basin* series (Anschuetz et al. 1990; Doleman et al. 1991; Doleman et al. 1992). This eight-year research endeavor conducted on the western slopes of the Jarilla Mountains on the White Sands Missile Range near Orogrande, New Mexico, represents one of the first attempts to systematically study the organizational character of the archaeological record within this region.

The Borderstar 85 survey (Seaman et al. 1988) was conducted in a manner similar to that of Tobin Well. The conclusions reached by this project include:

- Sample survey methods of large areas are inadequate to the task of recording all the significant organizational variability in the archaeological record of the Tularosa Basin and Hueco Bolson. Comparison of Phase I survey data collected using 2-by-30-meter transect recording units to total survey using 5-meter spacing of several 500 square meter Phase II quadrats showed that the Phase I system underrepresented the archaeological content by 67% (Seaman et al. 1988: 140). The discrepancy is most likely due to the dispersed or aggregated nature (small sites versus large, high density sites) of a large part of the archaeological record in the Tularosa Basin and the difficulty in the visibility of cultural materials in a coppice dune environment.
- Related to the first conclusion is the nature of visibility of cultural materials and the extent to which they reflect (or do not reflect) buried cultural deposits.
- Chronological indicators (ceramic sherds, lithic technology, radiocarbon dates of features, obsidian hydration) need refining if firm temporal differences are to be established for assemblages. Such refinement should include the use of both survey and excavation data.
- Preliminary evaluation of Hard's (1983a) basin utilization model demonstrates that, although some correlations support it, overall the model does not identify diachronic change that may have occurred and the potential ramifications of these changes. Thus settlement pattern work by past researchers (Whalen 1977, 1978; Carmichael 1986) may have to be reexamined.

Seaman et al. (1988: 144) conclude by suggesting "that a new analytical approach founded upon new concepts of past human cultural behavior and its material by-products must be developed which better accommodates an empirical record characterized by larger rather than smaller scales of resolution." Some of the work and results from the Tobin Well project are a step in this direction.

The GBFEL-TIE Project (Anschuetz et al. 1990) addresses several problems highlighted in the Borderstar 85 Project. Analysis of the survey data and a geomorphological study of the project area reveal that for survey, a smaller transect interval (20 meters) and collection of quantified information concerning assemblage size and content allow for more unbiased analyses of the survey data and lead to more informed avenues of research. For example, survey data indicate that the alluvial fan zone appears to have been utilized in a different manner than the basin floor zone (Anschuetz and Chapman 1990). Such a hypothesis is not new, but the manner in which this hypothesis was conceived is a departure from more traditional site-based analyses. Survey data also indicate that small-scale landforms (dune ridges or high areas) are areas of higher artifact density, implying that behaviorally, these areas served a different function.

Further, a geomorphological study of the GBFEL-TIE Project area led to the conclusion that most of the archaeological record in the region lies in two stratigraphic zones (Doleman and Swift 1991). Cycles of erosion and deposition have altered the horizontal and vertical integrity of most archaeological sites, but not to the extent that behavioral patterns have been destroyed. These cycles have left what appear today as windows on a much larger and more complex archaeological record. Traditional site-based methodologies have proven ineffective at deciphering this complex pattern and have most likely hindered efforts to understand the nature of past human behavior.

Analysis of testing data (Doleman et al. 1991) from the GBFEL-TIE project area indicates that most sites are larger than surface data indicate. Buried site areas, at times, contain evidence of multiple occupations spanning several hundreds to thousands of years. Such findings further complicate the task of deriving correct behavioral meaning from the archaeological record. Several excavated sites were near ephemeral transition zone ponds and such locations may have adaptive importance. Further evidence for adaptive complexity is presented in synthetic analyses of both the Borderstar 85 and GBFEL-TIE databases (Doleman et al. 1992). Though the results of these analyses are tentative, they reinforce the fact that the archaeological record of the Tularosa Basin and Hueco Bolson is extremely complex. New methods will have to be devised to understand the nature of prehistoric settlement and subsistence patterns.

The purpose of the Borderstar and GBFEL-TIE discussion is not to present regional data for comparison with Tobin Well. However, it does illustrate the fact that the archaeological record of the region is complex and contains behaviorally relevant patterning. Only through extensive survey and testing projects will the goal of understanding the complex patterns of this record be realized.

Though not entirely successful at discerning patterns within the archaeological

record, the Tobin Well project contributes to the overall body of scientific knowledge of the region. This project also helped to raise awareness that the archaeology of the region is difficult to interpret because a variety of behavioral and natural processes acted upon the material items that past cultural systems left behind. The task of future research is to develop improved methods that aid in the quest to understand the organization of these prehistoric cultural systems. Such a goal is readily attainable if archaeologists are willing to shed the traditional for newer (and more complex) approaches to knowledge.

10
Management Recommendations

by

Chris Lowry

This chapter summarizes the work done on Project 91-14, the Tobin Well Archaeological Project, and provides recommendations for future work that may be carried out in the project area.

Summary

The Tobin Well project consisted of the survey and testing of 1.08 square kilometers located 1 kilometer north of the Biggs Army Airfield and adjacent to the existing Hawk Radar Facility on Fort Bliss. Survey and testing mitigated adverse impacts of construction activities as mandated by Sections 106 and 110 of the National Historic Preservation Act. Forty-eight prehistoric archaeological sites were recorded during the survey. All 48 sites were mapped and subjected to 100 percent surface collection. Sixteen sites were tested to evaluate their potential for protection under Section 110.

Recommendations

Both survey and testing revealed extensive archaeological deposits within the Tobin Well project area. Two sites (41EP4719 and 41EP4722) contain evidence of prehistoric structures and 41EP4719 contains two extensive, deep midden deposits. Most of the sites are in fairly stable dune-grassland areas, enhancing the chances of good preservation. Some sites contained several hundred surface artifacts prior to collection. Other sites contained very little in the way of artifact material, yet showed evidence of hearths. Sites like these are crucial in gaining a more complete picture of site types and their distribution through time. Further, very little archaeological investigation has taken place in the transition environmental zone. This project documents the importance of the area to prehistoric peoples of all time periods.

Since the time of the initial fieldwork and the write-up of this report, construction of launch pads for Patriot missiles has impacted a portion of the Project 91-14 area (Figure 10.1). Because of this, sites 41EP1610, 41EP4703, 41EP4704, and 41EP4717 have been destroyed. The rest of the project area, as of October 1994, remained undisturbed.

Table 10.1 lists sites discovered and tested during the fieldwork phases of this project and recommends eligibility under criteria (d) of 36 CFR 60.4 for nomination to the National Register of Historic Places for each site. Ideally, all sites are potential

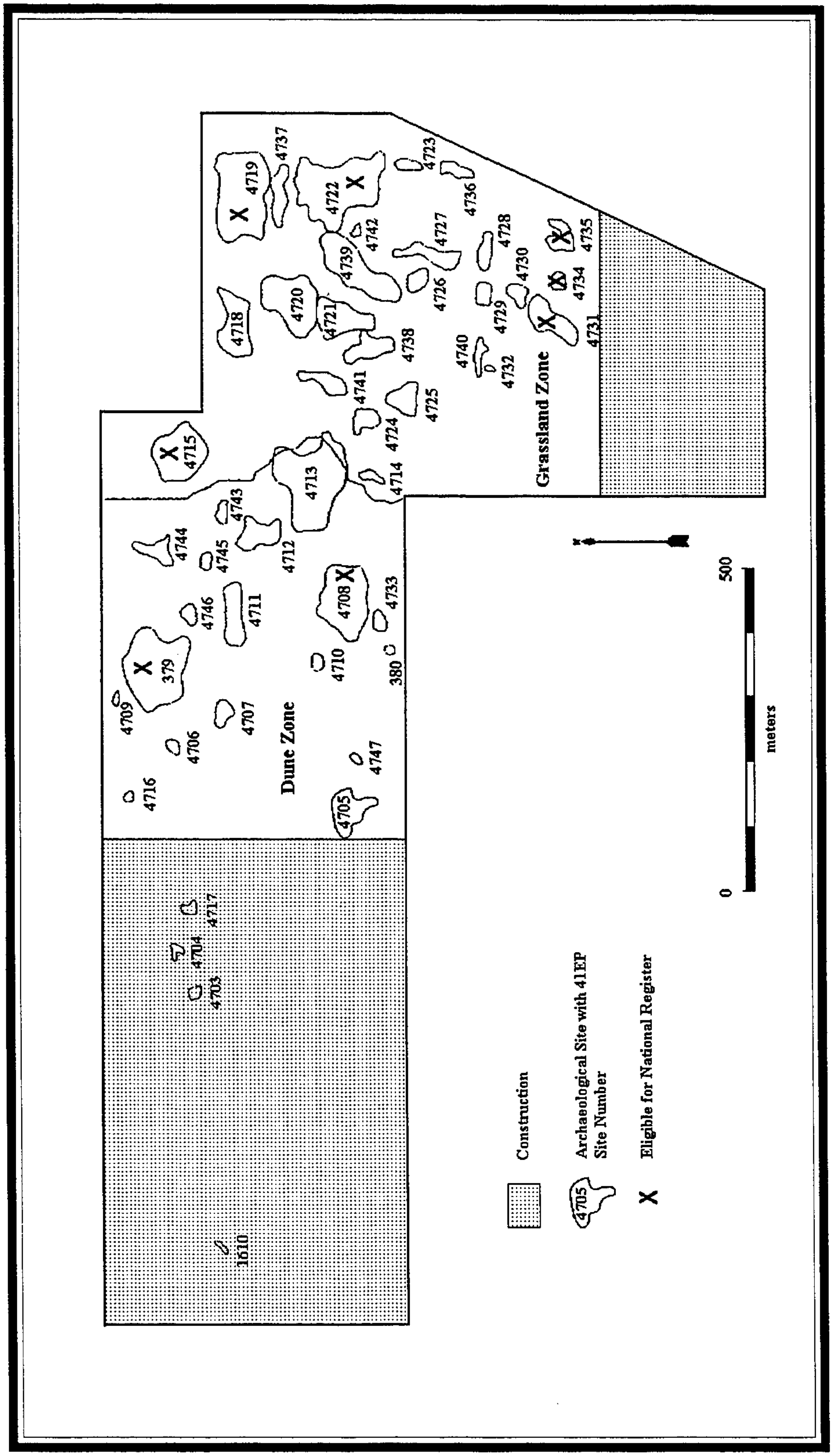

Figure 10.1. Areas Impacted by Construction

Table 10.1 Site Status.

Site #	Status	Subsurface Deposits	Dating Potential	Nat'l. Reg. Eligible	Comments
41EP379	Surveyed	Yes	Yes	Yes	
41EP380	Surveyed	No	No	No	
41EP4703	Tested	No	No	No	Destroyed
41EP4704	Tested	Yes	Yes	No	Destroyed
41EP4705	Surveyed	Possible	Possible	No	
41EP4706	Surveyed	Possible	Possible	No	
41EP4707	Surveyed	Possible	Possible	No	
41EP4708	Surveyed	Possible	Possible	Yes	
41EP4709	Surveyed	Possible	Possible	No	
41EP4710	Surveyed	Possible	Possible	No	
41EP4711	Surveyed	Possible	Possible	No	
41EP4712	Surveyed	Possible	Possible	No	
41EP4713	Surveyed	Possible	Possible	No	
41EP4714	Surveyed	Possible	Possible	No	
41EP4715	Surveyed	Yes	Yes	Yes	
41EP4716	Surveyed	Possible	Possible	No	
41EP4717	Tested	Yes	Yes	No	Destroyed
41EP4718	Surveyed	Possible	Possible	No	
41EP4719	Tested	Yes	Yes	Yes	
41EP4720	Surveyed	Possible	Possible	No	
41EP4721	Surveyed	Possible	Possible	No	
41EP4722	Surveyed	Yes	Yes	Yes	
41EP4723	Tested	Yes	No	No	
41EP4724	Surveyed	Possible	Possible	No	
41EP4725	Surveyed	Possible	Possible	No	
41EP4726	Surveyed	Possible	Possible	No	
41EP4727	Surveyed	Possible	Possible	No	
41EP4728	Tested	Yes	No	No	
41EP4729	Tested	Yes	Possible	No	
41EP4730	Tested	Yes	No	No	
41EP4731	Tested	Yes	Yes	Yes	
41EP4732	Tested	Yes	No	No	
41EP4733	Surveyed	Possible	Possible	No	
41EP4734	Tested	Yes	Yes	Yes	
41EP4735	Tested	Yes	Yes	Yes	
41EP4736	Tested	Yes	Possible	No	

(Continued on next page.)

Table 10.1 Site Status (Continued).

Site #	Status	Subsurface Deposits	Dating Potential	Nat'l. Reg. Eligible	Comments
41EP4737	Tested	Yes	No	No	
41EP4738	Surveyed	Possible	Possible	No	
41EP4739	Surveyed	Possible	Possible	No	
41EP4740	Surveyed	Possible	Possible	No	
41EP4741	Surveyed	Possible	Possible	No	
41EP4742	Surveyed	Possible	Possible	No	
41EP4743	Surveyed	Possible	Possible	No	
41EP4744	Surveyed	Possible	Possible	No	
41EP4745	Surveyed	Possible	Possible	No	
41EP4746	Surveyed	Possible	Possible	No	
41EP4747	Surveyed	Possible	Possible	No	

sources of data; however, it is not feasible to protect all of them. Most of the small sites are not nominated because a large sample of these site types has already been recommended for protection. Every effort should be made to protect site 41EP4719 as this site contains evidence of residential occupation that has been dated to a time period about which very little is known (the middle Formative period or Doña Ana phase). Further, the potential for buried remains is extremely high; it is quite possible that a pithouse village lies beneath these sands. Site 41EP4722 also contains evidence of residential occupation and should be protected. Site 41EP379 contains evidence of six distinct surface features, and more may be buried within the site area. Though no testing was conducted here, it is believed that both Archaic and Formative period components may lie buried here. The problem of multiple reoccupation may be addressed by examination of this site.

In addition to recommendations for eligibility to the National Register, the following cultural resource management actions are recommended:

1. Develop a comprehensive data recovery and mitigation plan if further undertakings will disturb archaeological deposits within the project area

2. Ensure that remaining archaeological sites are protected; to an extent this has already been done with the fencing off of the project area from further maneuvers. However, if further launch pads are to be constructed, Conservation Division personnel should be notified immediately.

Future Research

If the interpretation of the Tobin Well data is reasonably correct, future research should be devoted to gaining a better understanding of adaptation in the transition zone and the nature of the shift from a strategy based largely on hunting and gathering to one based on limited farming supplemented by hunting and gathering. More survey and testing will establish the spatial and chronological aspects of this time period. Further, collections of faunal and plant remains will enhance the subsistence database for this period as will studies into ceramic composition and lithic technology. Research in this region of the Southwest has been piecemeal, rather than coherent and informed, and has led to speculation about the how and why of cultural development in the Jornada Mogollon. Projects like Tobin Well are positive steps toward gaining a better understanding of the archaeology of the region.

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Appendix A
Site Descriptions

41EP379 (FB8007)

Elevation: 3,934 feet above mean sea level
Size: 9,880 square meters
Features: 6 Fire-cracked rock and/or burned rock features

Site 41EP379 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. The site is in Maneuver Area I of Fort Bliss, Texas, in the north-central part of the Tobin Well Project.

Whalen (1978:167) recorded the site as a small camp with ground stone and two hearths visible on the surface. No other artifacts were noted. Phase I reconnaissance investigations (surveyed at 15-meter-wide transect intervals) noted four areas containing features and artifact concentrations in the vicinity of the originally defined site area. The area is on the northeast edge of Site 41EP379. Phase I recorded two of the remaining concentrations. Archaeologists surveying during the Phase I reconnaissance were instructed not to define site boundaries; comprehensive surveying during Phase II identified boundaries. The final concentration was located during the Phase II fieldwork. Throughout most of the deflated interdunal areas a scatter of artifacts of varying intensity was found, suggesting that these concentrations may be part of a single site. A total of 521 artifacts was mapped on the site surface. The artifact types included ceramics, flaked stone debitage, flaked stone tools, ground stone fragments, hammerstone, fire-cracked rock, and burned caliche. All the cultural material on the site was in blowouts between large mesquite-anchored coppice dunes. The presence of a brownware sherd on Site 41EP379 infers a Formative period component, but additional components are possible. No other diagnostic artifacts were found on the site surface.

Feature 1, the apparent remnants of a hearth, is visible on the surface as a concentration of burned caliche and fire-cracked rock with an estimated 85 pieces of burned caliche and three pieces of fire-cracked rock scattered over an area of 16 square meters on the south side of a small eroded dune. Within the feature area, a 50-centimeter diameter cluster of burned caliche has potential for radiocarbon dating.

Feature 2 consists of about 25 pieces of burned caliche in an area of 12 square meters on the south side of an eroded dune. Several pieces of burned caliche are concentrated near the center of the scatter, and a slight gray stain is present in the southern part of the feature area. No other artifacts were observed within the boundaries of the feature. This feature also has potential for radiocarbon dating.

Artifact inventory:

El Paso Brown rim sherd	1
Undifferentiated brownware sherd	2
Debitage/chunk	3
Flake	17
Flake, utilized	6
Unimarginal retouch	1
Core	4
Hammerstone, rounded	2
Metate fragment	4
Other ground stone	22
Fire-cracked rock (13 not collected)	58
Burned caliche (not collected)	401
Total	521

Feature 3 consists of about 30 pieces of burned caliche in an area of 4 square meters. This feature is on the lower, south-facing slope of an elongated mesquite-anchored coppice dune. No stains were visible within the boundaries. One flake was collected from the feature. This feature may have potential for radiocarbon dating.

Feature 4 consists of approximately 30 pieces of burned caliche concentrated in a 1-square-meter area. The burned caliche is fairly clustered in a blowout in the middle of an old military two-track road and appears to be extensively eroded. No stains or artifacts were observed within the feature boundaries. This feature has little potential for radiocarbon dating.

Feature 5 consists of approximately 25 pieces of burned caliche and 4 pieces of fire-cracked rock concentrated in an area of less than 1 square meter; no stains were observed. This feature, which is near the edge of a blowout, may have potential for radiocarbon dating.

Feature 6 consists of about 125 pieces of burned caliche and 21 fire-cracked rocks in a 22-square-meter area. The feature also contained 2 pieces of angular debitage, 1 metate fragment, and 11 fragments of unspecified ground stone. Seven other pieces of ground stone are fire-cracked. The feature is on the west slope of a large mesquite-anchored coppice dune. A 30-centimeter-diameter dark gray stain and two small clusters of burned caliche are within the feature area. This area may represent more than one thermal feature and/or an activity area. This feature has the potential to yield enough charcoal for radiocarbon dating.

The lithic artifact collection from the site includes angular debitage, flaked stone tools, hammerstones, metate fragments, and unidentifiable ground stone artifacts. Many of the ground stone artifacts have been recycled as hearth stones and exhibit fire-cracking. The relatively high percentage of cores to flaking debris at the site suggests that lithic reduction was somewhat limited but played a role in the site activities.

Although unapparent from the descriptions, there are distinct differences in activities associated with the features. Distribution of flaked stone and ground stone varies in the immediate vicinities of the features. Features 1, 2, 3 and 4 have little, if any, flaked stone around them, and Feature 2 is the only one with associated ground stone. Features 5 and 6, however, have several flaked stone artifacts within 10 meters, including angular debitage, a unimarginal flake tool, and a core. These two features also contain a considerable quantity of ground stone, with much of it showing signs of thermal alteration. Most of the flaked stone found on the surface at the site is not in the immediate vicinity of visible features. This cursory examination of the distribution of surface artifacts suggests numerous varied activity areas. The cultural materials scattered over a considerable area suggest that this particular site may contain several small contiguous sites whose boundaries overlap. The single ceramic artifact, which was recovered from the west end of the site, is not associated with any of the visible surface features.

Site 41EP379 is in the transition zone, the interface between the Hueco Bolson desert floor and the Franklin Mountain alluvial fan. Although it appears similar to the small sites of the desert floor, differences may exist. More detailed data recovery at this site may assist in the determination of its function(s) and degree of multiple componency. Further investigation may discover the presence of additional subsurface features and artifacts in the less deflated areas of the site. Variation in dates obtained from carbon samples collected from the features, the investigation of variation in lithic types and/or tool types, technologies across the site and among cluster areas, and the recovery of additional ceramic materials are all potential research questions for additional investigations. This site is a good candidate for addressing many of these questions because of the number of possibly datable features and, in some respects, the density and distribution of flaked stone artifacts.

41EP380 (FB8004)

Elevation: 3,917 feet above mean sea level
Size: 190 square meters
Features: none

Site 41EP380 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. The site is in Maneuver Area I of Fort Bliss, Texas, and in the south-central section of the Tobin Well project area. It was recorded first in 1977 during the reconnaissance survey of Maneuver Area I (Whalen 1978: 166). The hearth with an associated ground stone artifact was plotted on a 1:3000-scale aerial photograph of the project area. Phase I survey and Phase II testing of the Tobin Well project area in 1991 did not find the hearth and ground stone identifying 41EP380. Southwest of the previously recorded feature were three flaked stone artifacts near the southernmost boundary of the earlier site limits adjacent to a deeply cut roadbed. These artifacts were in blowouts between mesquite-anchored coppice dunes primarily on the upper margins of surfaces and slumping toward the deeply bladed roadway. The site area north of the bladed roadbed may yet contain undisturbed subsurface deposits; however, the southern edge of the site that partially extended into the roadway has been removed by road grading. One artifact, a utilized flake tool, was outside the earlier site area shown on the map. It is included in the site discussions because of its proximity, along with the inability to confirm the exact location of 41EP380 defined by Whalen's investigators. No temporally diagnostic artifacts were present on the site, and the period of occupation is undetermined.

Artifacts found at the site included the two pieces of flaked angular debris and one utilized flake tool. The limited number of visible artifacts precludes anything but the most gross classification of site type or function. Given the small site size and low overall density of artifacts it is probably a temporary camp or special use area, but a more specific classification must be postponed until further investigations are conducted. The earlier recorded hearth and ground stone may be buried under the shifting coppice sand dunes at this site locale. Phase II investigators made no attempt to locate the subsurface feature. If the site's location is included within the final active military use of the property, archaeological testing is recommended to determine if the feature is intact. This may yield chronometric information, and adjacent activity areas may yield additional evidence related site function.

Artifact Inventory:

Debitage/chunk	1
Flake	1
Unimarginal retouch	1
Total	3

41EP1610 (FB8022)

Elevation: 3,948 feet above mean sea level
Size: 0.18 hectares
Area excavated: 2 square meters
Features: none

Site 41EP1610 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the western part of the Tobin Well project area in Fort Bliss Maneuver Area I. This site was recorded by Western Hueco Bolson Survey (Whalen 1978) as a hearth and one unidentified brownware sherd. The site form filed by Whalen indicates that the site was considered of low value and was 100% collected.

Site 41EP1610 was not found during the Phase I reconnaissance survey or the Phase II fieldwork. It is possible this site has been buried by windblown sand or obscured by a modern trash dump. The trash dump is a small concentration of broken rocks just east of the recorded site area that may have been incorrectly recorded as a hearth. The rock is highly fractured and resembles fire-cracked rock in some cases, but is actually road gravels similar to those at the original Hawk Missile Installation due south.

Two 1-by-1-meter test pits were excavated in the area where Site 41EP1610 was supposed to be located. No subsurface cultural materials were encountered and no further archaeological investigations are recommended at this site. The

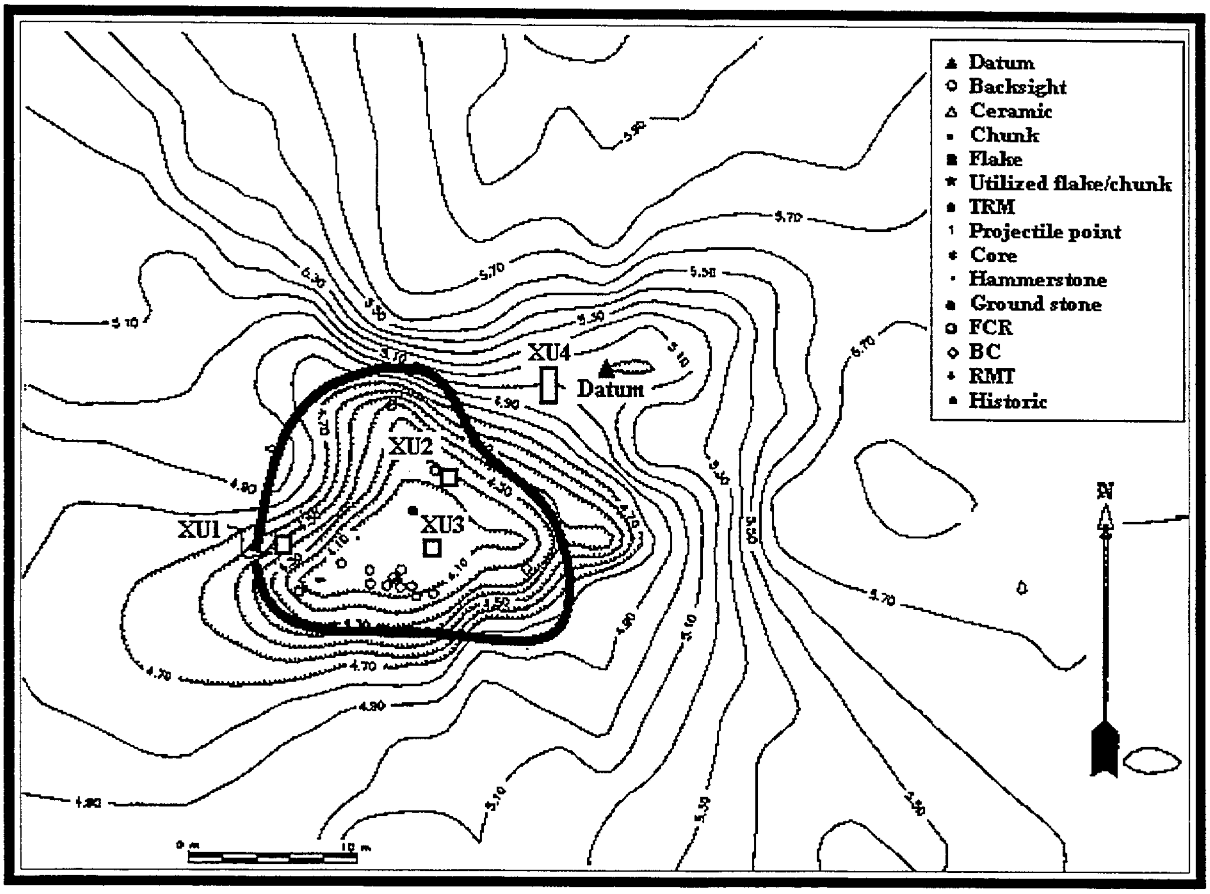

Figure A.1. Site 41EP4703.

initial 100% surface collection is believed to have exhausted the site's potential to provide useful information concerning prehistoric lifeways. The site is not considered to be eligible for the National Register, and no further archaeological investigations are recommended.

41EP4703 (FB11124)

Elevation: 3,922 feet above mean sea level
Size: 200 square meters
Area excavated: 5 square meters
Features: none

Site 41EP4703 (Figure A.1) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the western part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site, which Whalen recorded as a hearth, was not found during the Phase I reconnaissance of the project, but was subsequently rediscovered during the Phase II fieldwork. It was found to be in dune fields in the western part of the project area. The site's surface consisted of a dispersed scatter of burned caliche and fire-cracked rock distributed along a sloping depression surrounded by large mesquite-anchored coppice dunes. A total of 21 artifacts was mapped on the surface of Site 41EP4703. No temporally diagnostic artifacts were present on this site and no period of occupation can be determined.

Four test units covering an area of 5 square meters were excavated on the site. The units were placed to cover all topographic and geomorphic features within the site area in the vicinity of surface artifacts. A few very small pieces of burned caliche, one piece of

fire-cracked rock, and one piece of broken ground stone were recovered in Test Unit 2 near the north edge of the depression. The burned caliche was recovered from the loose blow sand on the unit's surface. The piece of fire-cracked rock and piece of ground stone occurred in fairly loose soil and do not appear to have been from primary context.

Artifact inventory:

Other ground stone	1
Fire-cracked rock	5
Burned caliche (uncollected)	15
Total	21

Site 41EP4703 apparently represents the eroded remnants of a single thermal feature, which appears to be completely eroded. All artifacts from the surface have been mapped, and all but the burned caliche have been collected. It is believed that the research potential of this particular site has been exhausted by already completed investigations. No further archaeological investigations are recommended.

41EP4704 (FB12400)

Elevation: 3,923 feet above mean sea level
Size: 345 square meters
Area excavated: 23 square meters
Features: 1 fire-cracked rock and/or burned rock feature, 1 stain

Site 41EP4704 (Figure A.2) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the western part of the Tobin Well project area in Fort Bliss Maneuver Area I.

Phase I reconnaissance originally recorded the site. It is about 50 meters northeast of Site 41EP4703 in an area of large mesquite-anchored coppice dunes. The surface of the site consisted of one fire-cracked rock feature eroding out of the side of a dune and a low density scatter of artifacts in adjacent depressions.

A total of 125 artifacts was recovered from the site, most of which are small pieces of burned clay. Fifty-one of these were on the site surface, and the remainder were recovered in test excavation units. The presence of brownware sherds on the site indicates a Formative period occupation.

Seven test units were placed across the site in a manner designed to not only cover the site area as identified by surface artifact distribution, but also to test the various geomorphic features present on the site. Unit 1 was placed over Feature 1, a burned caliche and fire-cracked rock scatter. The unit began as a 2-by-2-meter-square unit but was expanded as the feature expanded below surface. Unit 3 was placed near two pieces of burned caliche that were visible on the surface. A second charcoal stained area with associated burned caliche and fire-cracked rock, Feature 2, was below the loose surface blow sand. Test units 2, 4, 6, and 7 were placed across the site to test for intact subsurface deposits away from the visible surface concentration area. Unit 5 was placed between Feature 1 and Feature 2 to test for additional features and to provide additional artifacts to aid in site evaluation.

Feature 1 was partially exposed on the surface of the site. The feature was on the side of a large mesquite-anchored coppice dune and consisted of a tight 70-centimeter-diameter cluster of fire-cracked rock and burned caliche. Two brownware sherds, fire-cracked ground stone fragments, and a hammerstone were also exposed on the surface of the feature. Feature 1, which extended below the surface for 20 centimeters, contained a light gray stain and numerous pieces of fire-cracked rock and burned caliche. Many of the fire-cracked rocks are ground stone fragments. One flake and one core were also recovered from Feature 1. In profile the feature was slightly basin shaped but was not well defined. No charcoal was present within the feature. Stratigraphically, this feature rested on a surface of slightly compact, reddish, silty sand that formed a distinct contact with the overlying eolian dune sand. This surface was

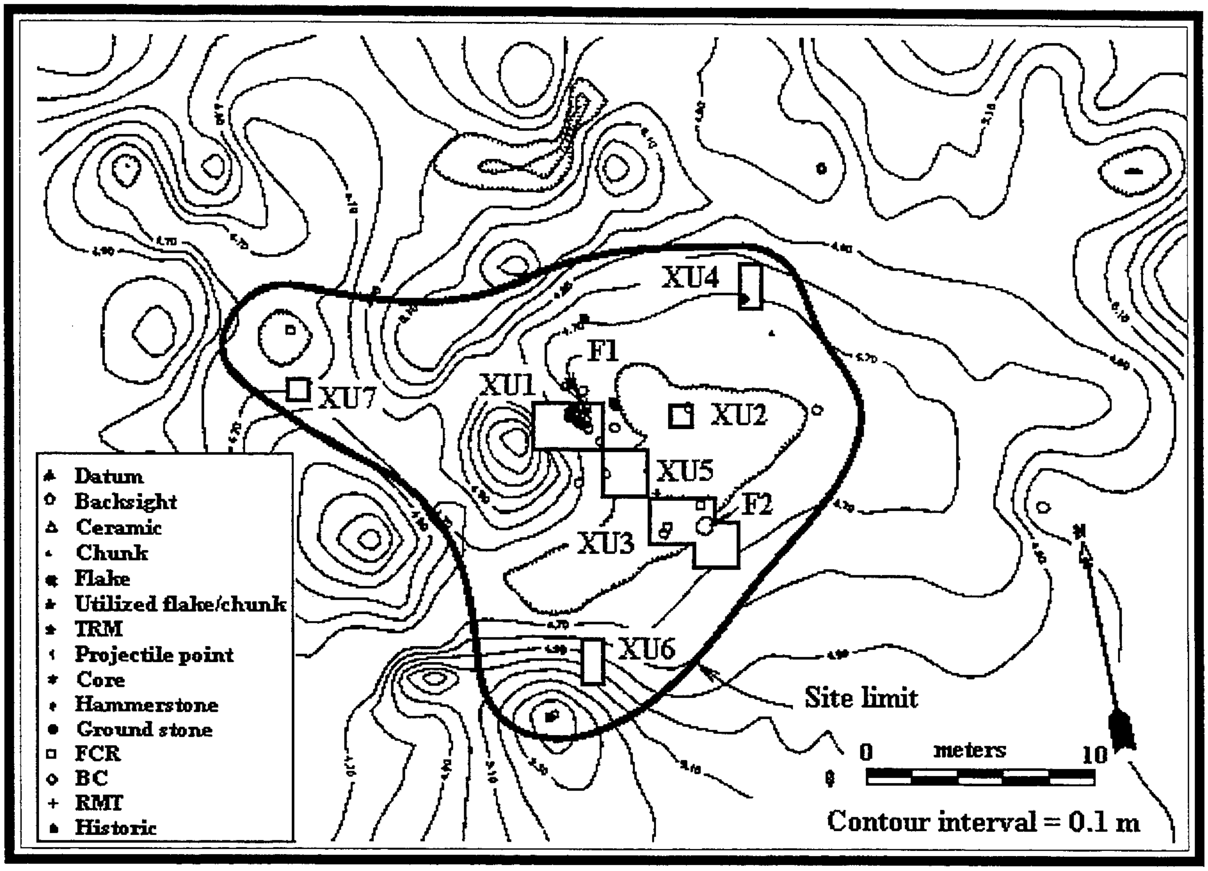

Figure A.2. Site 41EP4704.

truncated by erosion and was only present within the dune. The surface probably corresponds to the occupational level of this site.

Feature 2 was immediately below the blow sand in the bottom of a blowout about 8 meters southeast of Feature 1. Two pieces of burned caliche were on the surface just west of this feature. Feature 2 consisted of a 40-centimeter-diameter, amorphous, dark gray stain with small charcoal flecks. The main part of the stain was only about 5 centimeters thick but mottled stains continued 14 centimeters below the top of the feature. Several small pieces of fire-cracked rock and burned caliche were within the feature. Five flakes and a core were also recovered from the feature. Feature 2 occurred at a level about 40 centimeters below the top of Feature 1. It appears that Feature 2 represents the highly eroded remains of a hearth, the top of which may have originally been at the same elevation as Feature 1. Enough charcoal for radiocarbon dating could not be obtained from Feature 2.

Artifacts and sample inventory:

Undifferentiated brownware sherd	2
Debitage/chunk	3
Flake	3
Utilized Flake	1
Core	1
Hammerstone, angular	1
Hammerstone, rounded	1
Mano fragment	1
Metate fragment	6
Mano/metate fragment	1
Other ground stone	18
Fire-cracked rock	28
Burned caliche	5
Burned caliche (uncollected)	39
Fire-cracked rock/burned caliche	1

^{14}C	1
Flotation	6
Pollen	7
Total	125

Very few subsurface artifacts were recovered during excavation. In general it appears that this site has been eroded as the features were only partially intact. Test units across the site area indicate little potential for other intact features or significant deposits on Site 41EP4704. No further archaeological investigations are recommended at this site.

41EP4705 (FB12401)

Elevation: 3,933 feet above mean sea level
Size: 2,950 square meters
Features: 1 stain with fire-cracked rock and burned caliche

Site 41EP4705 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in Maneuver Area I of Fort Bliss, Texas, in the south-central part of the Tobin Well project area at the limit of currently proposed construction activities.

The site comprises a fairly large artifact concentration dispersed along a linear, deeply bladed cut that shows up as an east-west depression running through the site. This site was originally recorded during the Phase I survey as a small scatter of artifacts that included fire-cracked rock, burned caliche, and one flake. Phase II investigations at much closer interval spacings indicate the site is considerably more extensive, with a broader range and higher numbers of artifacts. A total of 131 artifacts was mapped on the surface of the site. One brownware sherd, the only temporally diagnostic artifact recovered, indicates at least one possible Formative period use of the site area. The sherd may be part of the assemblage associated with Feature 1, as it is in the general vicinity but southwest of the feature. Much of the cultural material was concentrated near the northeast edge of the site. A second, less intense, scatter occurs along the southern slope of the line of dunes making up the northern boundary of the site. The remainder of the site area contains only a light scatter of cultural material. Large mesquite-anchored coppice dunes around the edge of the site may contain buried cultural materials.

Feature 1 is a small, diffuse light gray stain on the southern slope of a large dune. Approximately 10 pieces of burned caliche and 5 pieces of fire-cracked rock are scattered downslope away from the actual stain. These materials are not contained within the stain and have not been tabulated as part of the feature because of the inability to correctly identify which of the near-by artifacts are actually from the feature and which are from the surrounding activity area. Two ground stones recovered from the site are also classified as fire-cracked rock and have apparently been utilized as hearth stones. This feature appears to be extensively eroded and possibly disturbed by mechanical grading and has little surface evidence potential for radiocarbon dating.

Artifact inventory:

Undifferentiated brownware sherd	1
Debitage/chunk	4
Flake	6
Flake, utilized	10
Core	1
Hammerstone, angular	1
Hammerstone, rounded	1
Mano fragment	1
Metate fragment	6
Other ground stone	18
Fire-cracked rock	11
Burned caliche	31
Glass	40
Total	131

The distribution map of artifacts does not suggest distinct site use areas with the exception of the area around Feature 1. There are no other readily apparent artifact clusters or variations in artifact types present across the site. It is possible that many of the artifacts scattered to the west of the feature were originally associated

with the feature and have been displaced by heavy equipment grading the central site area. The bladed area is widest in the central and western areas of the site but continues in a constricted corridor to the east just south of the exposed feature.

The variety of artifact types at the site suggests either multiple-use components or multiple site activities during a single occupation. Regardless of the number of times the site was inhabited, it is likely that it did not receive intensive use for any appreciable length of time. Subsurface testing of the peripheral site areas is needed to substantiate these conclusions and establish the presence or absence of intact subsurface cultural deposits at the site.

41EP4706 (FB12402)

Elevation: 3,930 feet above mean sea level
Size: 370 square meters
Features: 1 fire-cracked rock and/or burned rock feature, 1 stain

Site 41EP4706 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas, in Maneuver Area I of Fort Bliss in the north-central part of the Tobin Well project area. This site was first recorded during the Phase I reconnaissance (15-meter-wide transects) survey of the project area as a stain with one piece of burned caliche or fire-cracked rock and a small scatter of fire-cracked ground stone. Phase II investigations at the site conducted at much closer transect intervals revealed a second small feature and a larger site area. Large mesquite-anchored coppice dunes are around the entire perimeter of the site where subsurface testing may reveal buried cultural evidence. A total of 17 artifacts was mapped on the surface of the site. No temporally diagnostic artifacts were present and no period of occupation can be determined. Most of the cultural material was eroding out of the southeastern slope of a large mesquite-anchored coppice dune or in an adjacent blowout.

Surface artifacts are generally within an interdunal blowout that shows evidence of having been deflated nearly to the underlying caliche. This evidence is in the form of a large number of caliche gravels scattered over the blowout surface. Interdunal areas peripheral to the artifact concentration may retain intact cultural materials. No diagnostic artifacts were recovered from the site.

Feature 1 consists of a scatter of about 30 pieces of burned caliche and 10 pieces of fire-cracked rock in a 2-square-meter area eroding out of the east slope of a large mesquite-anchored coppice dune. Artifacts within this feature were not collected during the surface collection, but were left in place for later mapping and photographing. Almost all fire-cracked rocks are ground stone fragments, one of which could be identified as a mano fragment. A 4-square-meter concentration of burned caliche and fire-cracked rock is present within the feature area. A 50-centimeter-diameter area of dark gray stains with burned caliche is also present within the feature. This feature appears to be extensively eroded but has the potential to yield enough charcoal for radiocarbon dating. This may yield additional information related to subsistence strategies at this site.

Feature 2 is a small, 25-centimeter-diameter dark gray stain in a blowout. Burned caliche, fire-cracked rock, and artifacts were not observed in association with this feature. This feature may also have the potential to yield enough charcoal for radiocarbon dating.

Artifact inventory:

Mano fragment	2
Fire-cracked rock	7
Burned caliche	8
Total	17

One mano fragment was recovered from the site during the surface collection. Additional ground stone fragments present within Feature 1 were not collected and are not included in the

totals. Flaked stone and other varieties of artifacts are noticeably absent from the collection. The site does not represent an occupation of any considerable length of time. Features show promise of containing sufficient carbon for obtaining dates for the period of site occupation. Whether significant other cultural materials remain in intact subsurface context remains unknown pending subsurface testing.

41EP4707 (FB12403)

Elevation: 3,930 feet above mean sea level
Size: 920 square meters
Features: 1 fire-cracked rock and/or burned rock feature

Site 41EP4707 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the coppice dune region in the central part of the Tobin Well project area in Fort Bliss Maneuver Area I. Site 41EP4707 was recorded during the Phase I (15-meter-wide transect) reconnaissance survey as a 400-square-meter artifact scatter with one burned caliche and fire-cracked rock feature. One flake and a core were also noted on the site surface. Phase II investigations conducted at more closely spaced intervals show that the scatter of material covers a larger area and includes ceramics in its assemblage.

The burned caliche and fire-cracked rock feature is near the east edge of the site, and a cluster of five ceramic sherds are near the western margin. A few pieces of burned caliche and flaked stone artifacts are dispersed in a blowout west of Feature 1. Brownware sherds from the site indicate a Formative period occupation. A total of 24 artifacts was mapped on the site surface. No other temporally diagnostic artifacts were present on this site and no other specific periods of occupation can be determined. Large mesquite-anchored coppice dunes, which might contain buried cultural materials, are around the entire perimeter of the site. Subsurface testing within the mesquite-stabilized dune region may provide additional prehistoric cultural evidence.

Feature 1 consists of a cluster of eight pieces of burned caliche, three fire-cracked rocks, and one fragment of ground stone in an area of 1 square meter. This feature is on the lower northeast-facing slope of a very large mesquite-anchored coppice dune. This feature appears to be eroded and has little potential to yield enough charcoal for radiocarbon dating.

As with other sites in the dune field area of the project, artifacts found on the surface at this site were all recovered from the eroded interdunal part of the site area. Hence, testing within the interdunal areas will perhaps reveal more extensive cultural evidence not addressable with surface evidence alone. This collection includes ceramics, flaked stone tools and flaking debris, and one piece of ground stone. These artifacts occur in low density and are scattered over an area of some 920 square meters. The cluster of ceramic sherds is somewhat separated spatially from other cultural materials on the site and it possibly represents a distinctly separate period of site use, or perhaps a ceramic concentration created by relic collectors. It is also possible the dune that now separates the small ceramic cluster from the other artifacts at the site is a relatively recent phenomenon and, in fact, creates a false sense of separation of the cultural material. Lithic cultural material extends along the main blowout area to a point actually farther west than the ceramic cluster.

Artifact Inventory

Undifferentiated brownware sherd	4
El Paso Brown rim sherd	1
Flake, utilized	1
Core	1
Other ground stone	1
Fire-cracked rock	3
Burned caliche	11
Total	22

The low artifact density at Site 41EP4707 indicates that this locality served as a short-term camp or activity area. The single feature visible on the site surface is apparently the remnants of a hearth or other heat-related feature. This cultural manifestation is severely eroded and not likely to produce carbon for dating. The presence of artifacts beyond the central blowout area, however, suggests that this site may retain intact cultural deposits in the less deflated areas within its defined limits, particularly near or under the dunes.

Subsurface site testing is needed to substantiate observations made during the surface reconnaissance at the site. Such testing will answer questions concerning the degree of erosion of the single feature and the presence or absence of intact cultural material at the site. The presence of cultural material beyond the dunes that encircle the main part of the site suggests that the dunes may be a relatively recent occurrence and that they may have concealed and protected other cultural material and features.

41EP4708 (FB12404)

Elevation: 3,933 feet above mean sea level
Size: 7,075 square meters
Features: 2 fire-cracked rock and/or burned rock features

Site 41EP4708 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. The site is in the southeast-central part of the Tobin Well project area in Maneuver Area I of Fort Bliss, Texas. Phase I reconnaissance survey (15-meter-interval transects) of 41EP4708 recorded sites 6927K, L, M, and N (temporary site numbers). Site M is the most northwest of the group; site N the northeasternmost; Site K, the southwestern; and Site L, the southeasternmost. Site K was identified as a single burned caliche and fire-cracked rock feature associated with two El Paso Brown rim sherds. Site L was identified as a scatter of ground stone, flakes, and fire-cracked rock covering an area of 100 square meters. Site M was defined as a single stain containing burned caliche and associated fire-cracked rock and one flake. Finally, Site N was defined as a small scatter of El Paso Polychrome sherds. Information concerning quantities of artifacts by type were presented in the survey field book and within the survey transect forms. Due to the Phase I survey crews instructions, they did not investigate these artifacts to determine which temporary sites were in actuality small components of larger ones. This was scheduled as part of intensified Phase II research. Phase II investigations recorded the artifact scatters as irregularly interspersed between the previously identified site areas, and additional artifacts were found to the east of the originally defined sites. These areas with the additional artifacts have also been included within 41EP4708.

This site consists of several artifact and feature concentrations distributed in several blowouts between dunes. A total of 513 prehistoric artifacts and 6 pieces of historic glass were mapped on the surface of the site. The densest artifact scatter was near the southwest edge of the site and contained hundreds of flaked stone and ceramic artifacts, burned caliche, and fire-cracked rock. Ceramics were recovered from the site during surface collection and mapping. Of these, 100 are brownwares, most from the artifact concentration area in the southwest part of the site. The rim sherds have pinched rims indicating a Mesilla phase occupation, and the presence of two El Paso Polychrome sherds also indicates an El Paso phase occupation. Feature 1 is within this concentration. The high density and diversity of artifacts in this southwest concentration suggests that habitation structures may be present. Testing for specific activity areas as well as structures at this location is recommended if this site is going to be adversely affected by military activities.

Artifact inventory:

Undifferentiated brownware sherd	100
El Paso Brown rim sherd	9

El Paso Bichrome sherd	5
El Paso Polychrome sherd	2
Debitage/chunk	9
Tested pebble/cobble	1
Flake	56
Flake, utilized	13
Core	1
Hammerstone, angular	1
Hammerstone, rounded	1
Mano fragment	1
Metate fragment	2
Mano/metate fragment	2
Other ground stone	37
Fire-cracked rock	25
Burned caliche	242
Glass	6
Total	513

Another concentration of artifacts was located in the northwestern part of the site. Lithics, ceramics, ground stone, burned caliche, and fire-cracked rock were present in this concentration. One feature (Feature 2) is in this area of the site.

The remaining concentrations on Site 41EP4708 had moderate artifact densities and did not contain features. A few artifacts were scattered between the main concentrations. Large mesquite-anchored coppice dunes, which might contain buried cultural materials, are on and around the entire site. A large dune field on the west edge of the site has the highest potential to yield buried cultural manifestations.

Feature 1 consists of a cluster of 33 pieces of burned caliche in an area of 6 square meters in a blowout. No stain was observed within the feature. One mano/metate fragment, two unidentified ground stone fragments, one core, and four brownware sherds were within the feature area. This feature appears to be eroded and the absence of stains indicates there is little potential for radiocarbon dating.

Feature 2 consists of a cluster of 68 pieces of burned caliche in an area of 4 square meters in a blowout. Most of the burned caliche is concentrated in a 1-square-meter area that contains dark gray stains. One piece of angular debitage was collected from within the feature. This feature has potential for radiocarbon dating.

It is apparent from ground observations that the artifacts are clustered between dunes in blowout areas. Clustering of these surface artifacts in and around the various depressions on the site suggests that much of the visible cultural material may be a result of differential erosion and resulting exposure. It is likely that some of these artifact clusters are related to the same occupation of the site, but it does not necessarily mean that all clusters are remnants from the same period of occupation.

The ceramic assemblage may indicate at least two periods of site occupation, Mesilla phase (pinched El Paso Brown rim sherds) and El Paso phase (El Paso Polychrome). These two proposed aspects of site occupation may be separate, as the two El Paso Polychrome sherds were spatially separate from other ceramics at the site. Both sherds were recovered from the extreme northern limits of the defined site area. Another scenario is that the El Paso Polychrome may actually be affiliated with a transitional occupation of the site whereby El Paso Brown pottery was contemporaneously used. The distribution of lithic material is less convincing as a means of splitting the site area into multiple sites or activity areas. Lithic materials, including burned caliche and fire-cracked rocks, occur over most of the site and do not show any readily apparent differences among cluster areas in terms of general types. Clusters of artifacts at the site may result from any or all of several reasons including: (1) periods of multiple site occupancy, (2) separation of activity areas during occupation, or (3) differential deflation resulting in the appearance of artifact concentrations. It seems likely that a combination of these reasons is responsible for the current artifact distribution structure of the site. Chronometric dating and subsurface testing at this site may better reveal these propositions.

Subsurface testing at this site should provide datable carbon for radiocarbon dates as well as additional diagnostic artifacts for studying component distribution. One of the features visible on the surface is believed to be sufficiently intact to provide carbon for dates and it is likely, given the artifact density and dispersion, that additional features are present below the surface. Subsurface testing of less deflated areas will also provide evidence supporting or refuting the visible surface artifact concentrations as distinct sites or activity areas.

Site 41EP4708 is similar to many other sites on the basin floor, particularly those found in the coppice dune fields. It is similar in the number of artifact and/or feature clusters separated generally by little more than a dune or area of less pronounced deflation. Surface data is generally inconclusive in determining the relationships between these concentrations through space and time. The high density of artifacts and probability for recovery of additional time-diagnostic materials suggest that this site can provide answers concerning the relationships among the various visible artifact concentrations at the site.

41EP4709 (FB12405)

Elevation: 3,932 feet above mean sea level
Size: 165 square meters
Features: 1 fire-cracked rock feature

Site 41EP4709 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the north-central part of the Tobin Well project area in Maneuver Area I of Fort Bliss, Texas. The site was initially recorded during the Phase I reconnaissance survey (15-meter-wide transects) as a fire-cracked rock feature with no other associated artifacts. Phase II investigations modified this configuration through the implementation of intensified surveying strategies. The site is visible on the surface as a single fire-cracked rock feature and a small scatter of two fire-cracked rocks and two pieces of burned caliche 16 meters east of the feature. Eleven artifacts were mapped on the surface of this site. No temporally diagnostic artifacts were present and no occupation period can be determined. All the cultural material was around the perimeter of a single large mesquite-anchored coppice dune. A fence line bounds the north edge of the project area.

Feature 1 consists of a cluster of seven large pieces of fire-cracked rock in an area of less than 1 square meter. Almost all the fire-cracked rocks appear to be fragments of ground stone. No stains or other artifacts were associated with this feature. The feature appears to have little potential for radiocarbon dating.

It is apparent that this site was not used for any extended length of time. There is no strong evidence to link the materials from the two small clusters. It is possible the two artifact clusters represent more than a single period of site use, but it is also possible they are remnants of a single period of occupation. Subsurface testing can be expected to provide further evidence concerning the extent of erosion of cultural material bearing sediments and better define the horizontal extent of the cultural materials. The thicker sands along the southern base of the dune between the two artifact clusters may be concealing additional cultural materials and creating the impression of separate site areas. The fire-cracked rock feature should be tested to determine the extent of erosional damage and to determine the presence or absence of datable carbon.

Artifact inventory:

Mano/metate fragment	1
Other ground stone	5
Fire-cracked rock	3
Burned caliche	2
Total	11

41EP4710 (FB12406)

Elevation: 3,932 feet above mean sea level
Size: 410 square meters
Features: 2 burned caliche features

Site 41EP4710 is along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the central part of the Tobin Well project area in Fort Bliss Maneuver Area I. This site, originally described a single burned caliche and fire-cracked rock feature approximately 1 meter in diameter, was recorded during the Phase I reconnaissance survey (using 15-meter-wide transects). Phase II investigations using more intensified survey strategies describe the site as two burned caliche features and a dispersed scatter of burned caliche. Both features were eroding out of the side of a dune. The material scatter covers an area of approximately 410 square meters. One piece of angular debitage was also present. A total of 39 artifacts was mapped on the surface of the site. No temporally diagnostic artifacts were present, and no period of occupation could be determined. The remaining burned caliche is scattered throughout a blowout. Large mesquite-anchored coppice dunes are present around the entire perimeter and cultural material may be present beneath these deposits.

Feature 1 is a cluster of about 10 pieces of burned caliche in a 4-square-meter area on the north slope of a dune. No stains or artifacts were observed in association with this feature. This feature appears to have little potential for radiocarbon dating.

Feature 2 is a cluster of nine very small pieces of burned caliche and a single piece of debitage in a 2-square-meter area on the east slope of the same dune as Feature 1. This feature may actually represent a scattering of material from Feature 1. No stain was observed in association with Feature 2. Surface indications suggest this feature has little potential for radiocarbon dating.

Artifact inventory:

Debitage/chunk	1
Burned caliche	38
Total	39

Surface indications infer that 41EP4710 functioned as a short-term camp or activity area. The very restricted range of artifact types at the site suggests little variety in the types of associated activities. Subsurface testing is needed to determine the integrity of the features and other possible subsurface cultural deposits. It appears likely that the site is deflated; however, peripheral dunes may still contain prehistoric materials.

41EP4711 (FB12407)

Elevation: 3,933 feet above mean sea level
Size: 2,625 square meters
Features: 2 fire-cracked rock and/or burned rock features

Site 41EP4711 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. Large mesquite-anchored coppice dunes are on and around the entire site. It is in the central part of the Tobin Well project area in Fort Bliss Maneuver Area I.

Site 41EP4711 was recorded during Phase II investigations in the project area after more intensified surveying efforts were employed. It was visible on the surface as two fire-cracked rock and burned caliche features with a dispersed scatter of artifacts. The two features are some 80 meters apart and are included within a single site because of an intermittent scatter of cultural materials between them. With such distance between these two features, it is unlikely they are contemporaneous. Both features are eroding out of the side of dunes. The remaining items on the site were scattered throughout a few blowouts.

A total of 97 artifacts was mapped on the surface of Site 41EP4711. One brownware sherd from the east end of the site indicates at least one Formative period use of the site.

Feature 1 consists of seven pieces of fire-cracked rock in an area of less than 1 square meter on the southern slope of a small eroded dune. Two of the fire-cracked rocks are ground stone fragments of quartzite and granite. The closest source for these materials is from the

eastern escarpment of Franklin Mountains and its affiliated alluvial fan. One hammerstone fragment is also present in the feature. No stains or other artifacts were observed in association with this feature. This feature appears to have little potential for radiocarbon dating.

Feature 2 consists of a cluster of about 20 pieces of burned caliche and 14 pieces of fire-cracked rock in a 6-square-meter area on the west side of a mesquite-anchored coppice dune. Eight of the fire-cracked rocks are fragments of ground stone. One piece of angular debitage was also present within the feature. Some organic stains, which are probably not cultural, are present in the feature. This feature appears to have little potential for radiocarbon dating.

Artifact inventory:

Undifferentiated brownware sherd	1
Debitage/chunk	4
Flake	10
Flake, utilized	3
Mano fragment	1
Other ground stone	22
Fire-cracked rock	48
Total	89

This site is probably the remains of at least two occupations as suggested by the two clusters of artifacts separated by approximately 50 meters. The intermittent scatter of material between the clusters served as the link for combining the materials within a single site. These materials are almost exclusively associated with highly eroded areas, which suggests the possibility of a more continuous scatter of material between the cluster areas that is not surface visible in the dunal regions. The brownware sherd from the east end of the site suggests a Formative period origin, but it is not directly associated with the feature. It is speculation at this time to place the feature's use to this period in prehistory. There is no surface indication at either feature that carbon is present for dating, but it remains possible that datable subsurface carbon remains at these locations.

It appears that this site combines two separate sites within its boundaries, but subsurface testing is needed to better address this issue and to determine whether the features contain datable carbon. This same testing should examine other areas for intact subsurface cultural materials, particularly in the potential activity area between the features. Surface materials indicate that the site resulted from short-term occupation(s) and did not serve as a base for a wide range of activities. The range of activities suggested is, however, broader than on many of the other dune area sites. The core, hammerstone, and angular debitage all indicate flaked stone tool manufacture activity in addition to an activity or activities associated with the fire-cracked rock features. Although some of the fire-cracked rocks at the site are also ground stone, the fragmentary nature of these rocks indicates they last served in heat-related activities and probably are not good indications for grinding activities at this site.

41EP4712 (FB12408)

Elevation: 3,934 feet above mean sea level
Size: 2,420 square meters
Features: none

Site 41EP4712 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the east-central of the Tobin Well project area in Fort Bliss Maneuver Area I. Large mesquite-anchored coppice dunes are present on and around the entire site.

Phase I reconnaissance survey (16-meter-wide transects) recorded the site as two isolated observations. Phase II investigations resulted in an upgrade to site status as a result of more time being allotted to comprehensively survey the area. This site is visible on the surface as a very low density artifact scatter dispersed throughout several blowouts. Some artifacts on the northwestern part of the site appear to be eroding out of a large mesquite-anchored coppice dune. Twenty-three artifacts were on the surface of the

site. Two ceramics from the site indicate at least one Formative period occupation.

Artifact inventory:

Undifferentiated brownware sherd	1
El Paso Bichrome sherd	1
Flake	2
Utilized flake	2
Mano/metate fragment	1
Other ground stone	4
Fire-cracked rock	10
Burned caliche	2
Total	23

There is no apparent clustering or real patterning in the distribution of the surface materials. The two ceramics from the site were recovered from within a few centimeters of each other and originally may have been part of the same vessel. The three flakes from the central part of the site, were too widely scattered to indicate association.

Much of the central blowout area in the north one-half of this site is badly eroded and caliche gravel exposures are common. The low density of artifacts and the lack of visible surface features, even in this eroded part of the site, suggest that the site may be predominantly deflated. There is a possibility for intact subsurface cultural material in the less eroded areas, but there is little to suggest they will contain any significant numbers of artifacts or features. Heavy military equipment and possibly grading have impacted the northern part of the site considerably. Subsurface testing is needed to check for intact cultural deposits in the built-up sandy areas.

41EP4713 (FB12409)

Elevation: 3,935 feet above mean sea level
Size: 11,100 square meters
Features: 1 stain

Site 41EP4713 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. A narrow, unimproved, north-south military trail runs through the site.

Site 41EP4713 was recorded during Phase II investigations of four isolated observations recorded by Phase I reconnaissance (using 15-meter-wide transect intervals). The site is an expansive scatter of cultural materials between dunes near the eastern edge of the dune field that covers the western part of the project area. The materials must certainly represent the remains of multiple periods of site use, but the nearly continuous scatter is broken primarily by dunes.

A variety of artifacts recovered from the site range from historic, civilian, and military materials to ground stone, flaked stone, and ceramics. An El Paso Polychrome rim sherd indicates one period of site use during the El Paso phase; this sherd is from the south-central part of the site and not within any of the areas with concentrated artifacts. Other less time-diagnostic ceramic sherds scattered across the eastern half of the site indicate a significant use of the site during the Formative period; however, the number of occupations represented by these materials is unknown. A projectile point recovered from the northern edge of the site suggests a pre-Formative or Formative period use of the site as well.

A single feature at the site is a gray stain that may be from diesel fuel rather than charcoal. This is possible as there is a considerable amount of recent debris of military origin at the site including unfired blank rifle cartridges, paint and fuel cans, and other items. Disturbance from heavy equipment is obvious in the extreme northeast corner of the site (which has been bladed flat) and in the break between dunes in the east central part of the site.

In general, the southeastern site area seems to offer the best possibility for buried cultural material as the sands here are deeper and less eroded. Cultural material on the extreme east arm of the site is from a drainage, which suggests intact cultural deposits in the surrounding built-up sands.

Artifact inventory:

Undifferentiated brownware sherd	1
El Paso Brown rim sherd	1
El Paso Bichrome sherd	3
El Paso Polychrome rim sherd	1
Debitage/chunk	2
Flake	26
Flake, utilized	8
Projectile point	1
Core	1
Metate fragment	3
Other ground stone	20
Fire-cracked rock	39
Burned caliche	62
Other lithics	1
Civilian artifact	3
Total	172

Many of the artifacts noted on the site are burned caliche or fire-cracked rock. These are scattered across the entire site with several distinct clusters and a general concentration within the central area of the site. Flaked stone artifacts are common, and flaked stone debris is particularly well represented and scattered across the entire site with no particularly high concentration areas. Cores and hammerstones are also a part of the collection and provide strong evidence for lithic reduction as common site occurrence. Utilized flake tools indicate site activities were not restricted to lithic reduction, however. Ground stone is present and tends to cluster in association with burned caliche and fire-cracked rock. At least four ground stones are fire-cracked rocks and their last function was as fire-cracked rock. It is possible that other ground stone fragments are also fire-cracked rock, but were not recognized as such.

The area within the limits of 41EP4713 is believed to represent the remains of several prehistoric sites from both the Archaic and Formative periods of prehistory. Portions of the site show evidence of considerable erosion, but the possibility for intact cultural deposits even within these areas remains. The likelihood that cultural materials remain intact is less in eroded areas nearer the dunes and in the thicker sands of the southeastern area of the site. Surface concentrations of burned caliche and/or fire-cracked rock indicate on-site heat-related activities and suggest that datable carbon may well be present in as yet unrecorded heating features. The presence of diagnostic artifacts from various periods of prehistory suggests that the site may be valuable in providing information concerning settlement and subsistence methods through time.

41EP4714 (FB12410)

Elevation: 3,935 feet above mean sea level
Size: 490 square meters
Features: 1 ash stain

Site 41EP4714 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. This site is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. One large mesquite-anchored coppice dune is on the east edge of the site.

Site 41EP4714 was not recorded through the Phase I 15-meter-wide transect survey, but was found and recorded during the more intensive Phase II investigations. The site is a low density scatter of artifacts and one feature. Most artifacts were dispersed along a well-used two-track military trail. A total of 21 artifacts was mapped on the surface of the site or in its immediate vicinity. No temporally diagnostic artifacts were present, so no period of occupation can be determined.

Feature 1 consists of white ash and charcoal flecks in a small pile of spoil dirt from an ant hole. Probing of the ant hole revealed the presence of dark gray soil and charcoal flecks to a depth of about 10 centimeter below the surface. The extent of the stain was not determined.

The flaked stone artifact collection shows surprising variety considering the low artifact count. Three artifacts in the site inventory that were collected beyond the defined site limits

include two pieces of ground stone and a bimarginal retouch tool. They are included in the inventory because of their proximity to the site proper, and because it is possible that the site extends to these artifacts. The site area contains built-up sands, and intact subsurface cultural deposits may exist. Subsurface testing is needed to identify site limits and density and quality of cultural material at the site.

Artifact inventory:

Flake	1
Flake, utilized	1
Unimarginal retouch	1
Bimarginal retouch	1
Core	2
Other ground stone	9
Fire-cracked rock	4
Total	19

41EP4715 (FB12411)

Elevation: 3,938 feet above mean sea level
Size: 5,525 square meters
Features: 1 artifact concentration with stain

Site 41EP4715 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. A few large mesquite-anchored coppice dunes are on Site 41EP4715. One large dune field, which probably contains buried cultural manifestations, is near the center of the site. Blowout areas between dunes are present on the north end of the site and beyond. A two-track military trail cuts through the dense artifact scatter from west to east.

Phase I reconnaissance survey of the project area described the site as an area of 400 square meters in grassland terrain. Phase II investigations identified a much broader surface scatter of artifacts covering some 5,525 square meters and extending beyond the grassland into dunes to the north. This site consists of a dense scatter of artifacts surrounded by a dispersed low density artifact scatter.

A total of 305 artifacts was mapped on the surface of the site. Many are pottery sherds including several examples of Type I and II style Mimbres Black-on-white. These ceramic types indicate a Mesilla phase or possibly a Transitional phase occupation.

Feature 1 consists of a very dense artifact scatter and slightly ashy soil in a 25-square-meter area in a blowout. A total of 75 artifacts was collected from this area. These artifacts consist of ceramic sherds, flaked stone items, ground stone fragments, fire-cracked rock, and burned caliche. The artifacts may have eroded out of a large dune field on the north side of the blowout. This feature may represent a sheet midden.

Stone artifacts are numerous on the site with a large amount of burned caliche and fire-cracked rock. As with the ceramic sherds, these materials cluster within the area designated as Feature 1. Burned caliche and ground stone fragments are the only artifact types that consistently occur beyond the limits of Feature 1. The feature contains a relatively dense concentration of flaked stone debris and two hammerstone fragments. Perhaps due to heavy surface collecting by relic hunters since the 1930s, no formal flaked stone tools are recorded.

Artifact inventory:

Undifferentiated brownware sherd	74
El Paso Brown rim sherd	4
El Paso Bichrome sherd	8
Mimbres Transitional sherd	1
Mimbres Classic sherd	3
Other Mimbres sherd	1
Chupadero Black-on-white sherd	9
Unpainted plain sherds	3
Debitage/chunk	4
Utilized chunk	1
Flake, utilized	6
Flake	55
Unimarginal retouch	1
Hammerstone, angular	1
Other ground stone	9
Fire-cracked rock	43

Fire-cracked rock (uncollected)	3
Burned caliche	44
Burned caliche (uncollected)	34
Worked sherd	1
Total	305

Two circular depressions on this site are the result of excavations for military maneuvers. No cultural material was noted in the back dirt from these excavations. The high density of artifacts present in the Feature 1 vicinity indicate a significant period of occupation at the site. The density of cultural material suggests an occupation of considerably longer duration than of the low density artifact scatters common in the dune field to the west. It is likely that the site contains the remnants of structures and other occupation related features that are buried under the built-up sands. Subsurface testing is needed to define site limits and document the presence of intact subsurface cultural material and features, but there seems to be little doubt that this site contains such material.

41EP4716 (FB12426)

Elevation: 3,925 feet above mean sea level
Size: 200 square meters
Features: 1 knapping station

Site 41EP4716 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the central part of the Tobin Well project area in Fort Bliss Maneuver Area I.

Site 41EP4716 was discovered and recorded during the more intensified surveying efforts of Phase II. It is a single dense scatter of flaked stone artifacts representing a knapping station (Feature 1). The main concentration of the knapping station was on the lower, east-facing slope of a large mesquite-anchored coppice dune. Other large mesquite-anchored coppice dunes surround the site. Flakes and pieces of angular debitage were present in an area of 12 square meters. It appears that all the flaked stone debris could be from a single cobble of limestone banded with chert. Three cores and three pieces of fire-cracked rock were also recovered from the feature. A total of 195 artifacts was mapped on the site. No temporally diagnostic artifacts were present on this site and no period of occupation can be determined.

The area in which Feature 1 is located shows obvious signs of deflation; however, during a return visit to the site additional artifacts were visible on the surface. The depth and integrity of these remaining sediments is unknown and subsurface testing is required to determine this. It is quite probable that significant deposits of cultural material remain beneath the slopes of the dunes. Subsurface testing is also needed to address site limits and presence or absence of associated features.

Artifact inventory:

Debitage/chunk	5
Flake	22
Flake, utilized	1
Core	1
Core fragment	2
Fire-cracked rock	164
Total	195

41EP4717 (FB12427)

Elevation: 3,924 feet above mean sea level
Size: 405 square meters
Area excavated: 27 square meters
Features: 1 fire-cracked rock and/or burned rock feature

Site 41EP4717 (Figure A.3) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the Tobin Well project area in Fort Bliss Maneuver Area I. Phase II investigations recorded the site about 50 meters east of Site 41EP4704 in an area of large mesquite-anchored coppice dunes. The visible surface characteristics of the site consisted of one fire-cracked rock and burned caliche feature situated in a depression. Another dispersed scatter of burned caliche was near the southwest

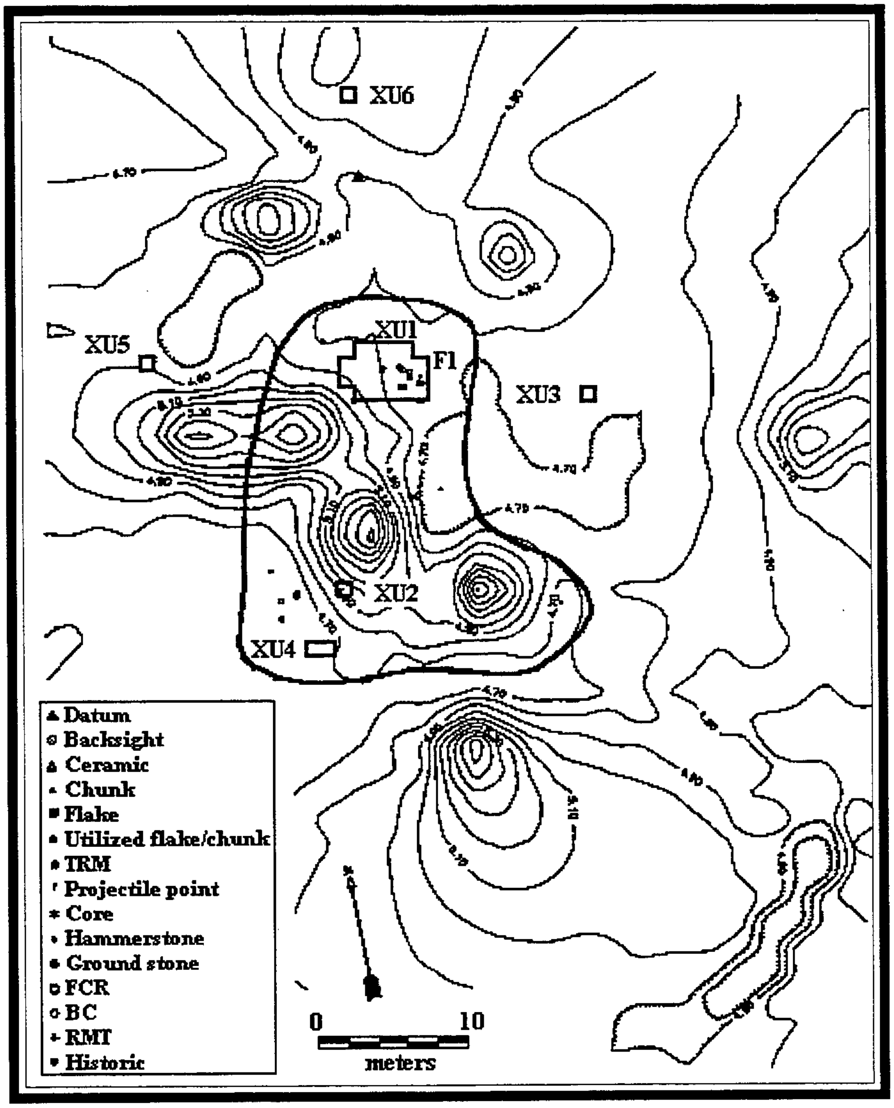

Figure A.3. Site 41EP4717

edge of the site. A total of 101 artifacts was mapped on the surface of Site 41EP4717.

Six test excavation units of varying sizes were spread across the site surface to test the entirety of the site area as well as artifact clusters, features, and a variety of the geomorphic feature types at the site. One highly eroded fire-cracked rock and burned caliche remnant of a hearth feature was excavated. No artifacts were recovered from below the surface outside the feature vicinity. A soil stain and burned rock remain, but the stain is diffuse with multiple darker areas, none of which is identifiable as original.

Feature 1 consisted of a dispersed, 3-meter-diameter scatter of fire-cracked rock, fire-cracked ground stone fragments, burned caliche, and flaked stone artifacts. A 75-centimeter-diameter area of gray stain associated with the feature was exposed just below the blow sand. A few charcoal flecks were present in the stain and throughout the rest of the feature area. The stain was diffuse, slightly basin shaped, and about 30 centimeters deep. A small

radiocarbon sample was obtained by combining all the charcoal recovered from a 21-square-meter area around Feature 1. It appears that Feature 1 had been eroded and was probably the remains of a hearth and associated activity area.

Artifacts and sample inventory:

Debitage/chunk	1
Debitage/chunk utilized	1
Flake	10
Retouched, Unimarginal	1
Other ground stone	5
Fire-cracked rock	56
Fire-crackéd rock	4
Burned caliche (uncollected)	8
Lithic artifact	1
^{14}C	7
Flotation	7
Total	101

Site 41EP4717 is similar to many small sites in the transition zone between the desert floor and the mountain alluvial fan. It is a small, low density scatter of artifacts associated with a heat-related feature. Artifact types show considerable variation relative to total quantity, yet the specific site function has not been determined. Flaking debris is present in sufficient quantity to indicate some lithic reduction and/or flaked stone tool production activity during site occupation. Ground stone at the site suggests food processing. Only 43 artifacts other than burned rock were recovered from the site, suggesting that site occupation was short-term, as does the relatively limited horizontal extent of cultural material.

This site's greatest potential for providing useful information is through its study as a member of a conglomeration of sites rather than an independent entity.

41EP4718 (FB12428)

Elevation: 3,924 feet above mean sea level
Size: 3,750 square meters
Features: none

Site 41EP4718 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the west-central part of the Tobin Well project area in Fort Bliss Maneuver Area I. No large mesquite-anchored coppice dunes are in the immediate vicinity of the site. In general, soils in the area of the site are fairly stable and vegetated with grasses and yucca.

The site was not recorded during the Phase I reconnaissance survey of the project area; however, two isolated artifacts were recorded in the site vicinity. Closer reconnaissance survey transects spaced at closer intervals during the Phase II investigations established the existence of the site.

The site is a moderately dense scatter of artifacts clustered mainly around a series of allthorn bushes. A small concentration of artifacts was also present about 30 meters west of the main concentration. Other small groups of artifacts were found in the fringe areas of the site. (Each of the concentrations or groups was associated with a deflation area.) A total of 156 artifacts was mapped on the surface of the site. Brownware ceramic sherds on the site indicate a Formative period occupation. Many of the artifacts near the allthorn bushes at the center of the site appear to be associated with spoil dirt from rodent burrows in the sediments around the brush.

Artifact inventory:

Undifferentiated brownware sherd	27
El Paso Bichrome sherd	1
Debitage/chunk	7
Flake	5
Utilized flake	1
Core fragment	1
Other ground stone	1
Metate fragment	1
Fire-cracked rock	91
Fire-cracked rock (uncollected)	1
Burned caliche	1
Burned caliche (uncollected)	20
Total	157

Ceramic sherds scattered throughout the site provide little evidence for distinct activity areas. Stone materials tend to cluster in the two main concentrations discussed above. Both concentrations primarily comprise burned caliche and flaked stone, although ceramic sherds are associated with both features. Wind erosion is the only really apparent site disturbance. The presence of artifacts in nearly all deflated areas and lack of artifacts over much of the undeflated areas of the site strongly suggest that intact cultural deposits remain beneath the surface. The deflated areas do not appear to be caused by caliche and may retain intact deposits. Subsurface testing is needed to better understand the site limits and site function, as well as to document intact cultural deposits including the likelihood of buried cultural features.

41EP4719 (FB12429)

Elevation: 3,948 feet above mean sea level
Size: 10,220 square meters
Area excavated: 50 square meters
Features: 2 middens, 1 stain, 1 pit structure
Dates: 5 ^{14}C

Site 41EP4719 (Figure A.4) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the northeastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is in a fairly stable, vegetated area with a few isolated large mesquite-anchored coppice dunes. Much of the northern and eastern portions of the site appear to be buried under deposits of eolian sand, whereas the southern part appears to be deflated.

Phase I reconnaissance recorded the site as three isolated observations. The site is just south of a large El Paso phase site (FB6849) intentionally excluded from the project area, and is situated in an elevated area of eolian sands with few shallow depressions. The site surface consisted of several scatters of ceramic sherds, flaked stone, ground stone artifacts, fire-cracked rock, and burned caliche with the heaviest densities on deflated or otherwise eroded areas. A total of 308 artifacts was mapped on the surface. The presence of El Paso Polychrome, Playas Red, and Chupadero Black-on-white indicates an El Paso phase occupation.

Forty-six test units covering 50 square meters were excavated on Site 41EP4719. Testing revealed two sheet middens, a stain, and a pit structure. All features occur in the northwestern part of the site in an area of built-up eolian sand. All test units with the exception of Unit 30 contained subsurface artifacts.

Feature 1 is a slightly mounded sheet midden in the western part of the site. A 1-by-7-meter hand-excavated trench was placed through this midden. The midden has a maximum thickness of 34 centimeters near the center and thins to about 10 centimeters near the edges. Although the exact dimensions of Feature 1 were not determined it is estimated to have a diameter of at least 10 meters. The soil in the midden consists of gray-stained, ashy, silty sand with abundant charcoal. A dark gray stain is present near the center of the feature. Artifact density in Feature 1 is extremely high, especially near the center. Recovered artifacts consist of ceramic sherds, flaked stone, ground stone items, fire-cracked rock, burned caliche, daub, possible pieces of plaster, and small fragments of burned bone. Diagnostic ceramics recovered consist of several El Paso Polychrome sherds and one possible Chupadero Black-on-white sherd. Two carbon samples from charcoal in this feature yielded uncorrected ages of 1070 ± 100 B.P. and 840 ± 80 B.P. (Beta 58413 and Beta 58414 respectively).

Feature 2 is a sheet midden in the north-central area of the site. A 1-by-4-meter hand-excavated trench was placed on the east edge of this midden. The midden has a maximum thickness of 18 centimeters and thins to 10 centimeters in some places. The dimensions of Feature 2 were not determined. Soil in the midden consists of gray-stained, ashy, silty sand with abundant charcoal. Artifact density in Feature 2

is extremely high, especially in the west half of the trench. Artifacts recovered consist of ceramic sherds, flaked stone, and ground stone items, fire-cracked rock, burned caliche, daub, one projectile point, and small fragments of burned bone. Two carbon samples from charcoal in this feature yielded uncorrected ages of 810 ± 80 B.P. and 860 ± B.P. (Beta 58415 and Beta 58416 respectively). Near the bottom of the midden deposits, approximately 30 centimeters below the surface, the stain became subrectangular in shape along the south wall of the trench. Although the nature of this stain could not be determined, it possibly represents a separate feature predating the midden deposits. A dark gray stain (Feature 3) was also present along the north wall of the trench at the same depth. A radiocarbon date from charcoal recovered from Feature 3 does not support a recognizable preexisting age for this feature, however, as the sample yielded an age of 710 ± B.P. (Beta 58417).

Feature 3 consists of a dark gray stain with abundant large pieces of charcoal. Approximately half of the feature was present in the trench. The stain is slightly basin shaped and about 10 centimeters thick in profile. Artifacts recovered from this feature consist of several pieces of fire-cracked rock, flaked stone items, and one brownware sherd. Three pieces of fire-cracked rock were present at the bottom of the feature. Approximately 110 items were recovered from this feature. Feature 3 may represent a hearth or refuse deposit.

Feature 4 is a pit structure located near the north edge of the site in an area of deep eolian sands. Only the western one-quarter of the structure was excavated. This structure has a maximum length of 2.3 meters along the west wall. The top of the structure is estimated to be about 55–60 centimeters below the present site surface. However, cultural material was recovered at about 20 centimeters above this level indicating that the fill may extend higher than could be defined.

Feature 4 extended approximately 45 centimeters into a deposit of caliche. The walls are formed by the caliche stratum and are perfectly vertical. The fill in the structure consists of dark brown silty sand with some charcoal flecks and caliche nodules. A few flaked stone artifacts, three ceramic sherds, fire-cracked rock, burned caliche, bone fragments, and a shell bead were recovered from the fill. One of the sherds is Chupadero Black-on-white. Approximately 370 items were recovered from Feature 4. A small amount of charcoal recovered from the feature is being submitted for extended count radiocarbon dating.

A profile of the structure indicates five subtle divisions in the fill of Feature 4. The lowest stratum of the fill consists of silty sand with abundant caliche nodules that may be caliche daub representing roof fall. An additional stratum, which could not be detected in the profile but was observed during the excavation of the fill, was present on the floor below the possible roof fall. This layer is about 3 centimeters thick and consists of dark brown silty sand with abundant charcoal flecks and several flaked stone artifacts.

The floor of the structure is a hard, level, prepared surface of caliche and clayey silt. Much of the floor is stained gray or has been oxidized. Two flaked stone artifacts were mapped on the floor and several other small flakes were recovered from the floor fill. Two possible postholes (Features 5 and 6) were in the excavated part of the floor. Both were investigated but neither could be determined to be cultural features.

Artifacts and Samples Inventory

Undifferentiated brownware sherd	262
El Paso Brown rim sherd	2
El Paso Bichrome sherd	53
El Paso Bichrome rim	4
El Paso Polychrome sherd	47
El Paso Polychrome rim sherd	6
Mimbres Classic sherd	1

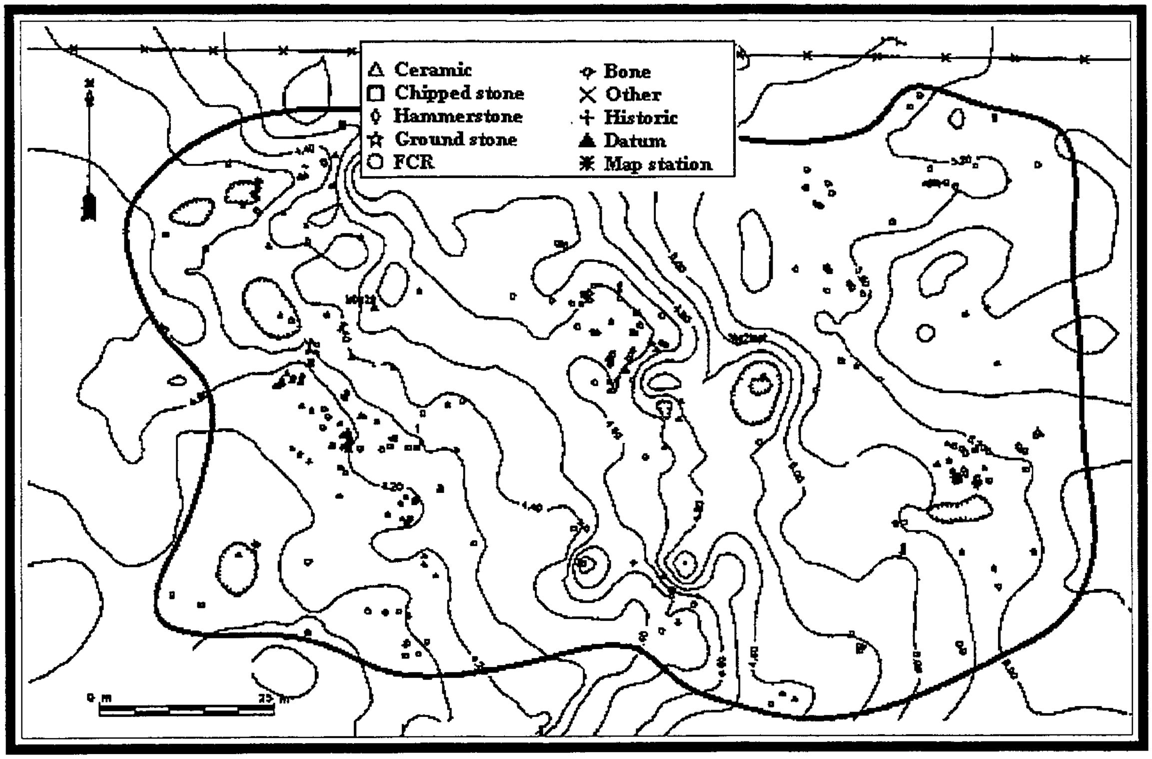

Figure A.4. Site 41EP4719

Chupadero Black-on-white sherd	2
Three Rivers Red-on-terra cotta sherd	1
Playas Red sherd	36
Unpainted plain sherd	20
Unpainted textured sherd	1
Painted monochrome sherd	1
Debitage/chunk	212
Tested pebble/cobble	1
Flake	415
Flake, utilized	58
Unimarginal retouch	1
Bimarginal retouch	1
General lithics	2
Projectile point	2
Core	7
Core fragment	1
Hammerstone, angular	1
Mano fragment	1
Metate fragment	1
Other ground stone	54
Fire-cracked rock	95
Burned caliche	27
Bone, nonhuman	130
Shell	1
^{14}C	53
Soil	1
Flotation	24
Total	1,524

Site 41EP4719 obviously represents more than a small, short-term campsite. As such, it can be expected that the site, as it is currently visible on the surface, is the result of a number and variety of activities. It is possible the site is the result of more than a single occupation; there is little evidence of multiple occupation. Activity areas are not readily definable from the artifacts visible on the surface. Artifacts occur across the site in apparent clusters, but a closer examination of this distribution clearly shows that geomorphological conditions are much more likely creators of these visible clusters than human activity.

Surface artifacts occur clustered across the site in deflated or otherwise eroded areas. There is a lack of surface visible artifacts near Feature

4. Surprisingly, in some cases evidence suggests a difference between the makeup of the surface artifact clusters and the subsurface collection. This is most obvious within the cluster near Feature 1 where surface artifacts included almost no fire-cracked rock or burned caliche while excavated collections contain significant numbers of these artifacts.

Regardless of whether specific surface artifact clusters can be defined to also represent discrete prehistoric activity areas, it is of interest that there appears to be little differentiation between the locations of ceramics and stone artifacts across the site. This is, perhaps, somewhat surprising given the expected differential artifact clustering normally associated with specific activity areas. The results discussed briefly here strongly indicate that substantial subsurface investigations are required to address questions of intrasite functionality.

Test units were placed across the site so that approximately one 1-by-1-meter test unit was placed in each 15-meter square identified by surface artifacts. These units reflect the surface distribution and suggest that the site may be larger than the surface indications. Peripheral test units yielded subsurface artifacts, which suggests that additional testing should be done around the currently defined site periphery to accurately identify site limits. Subsurface testing shows some evidence for separating the eastern part of the site from the western, either as separate site areas or as separate sites. This is suggested by the distinct lessening in artifact densities in units along a north-south line at approximately the 550 E line. Artifact types do not show a clear distinction.

This large site with high densities of artifacts and features has the potential to yield vast amounts of archaeological data from intact deposits and features. It can be expected to provide data about the use of the bolson during the El Paso phase of prehistory. It can and has provided information concerning dating of this prehistoric time period. Site middens can provide extensive artifact collections for comparative purposes both for other El Paso phase collections and for collections from sites of other periods in prehistory. The middens and other heat-related features will offer considerable carbon for additional datable material and food remains for addressing subsistence questions. The site is obviously a part of the settlement system used prehistoric people and can therefore address, in conjunction with other El Paso phase sites, settlement system questions both for the El Paso phase and other settlement systems through time. It is therefore recommended that future archaeological research at this site should include additional testing beyond the currently defined site limits. Block excavations are needed in the vicinity of the middens where a number of features have already been encountered, and additional testing and block excavations are needed to further address the possibility that the eastern part of this site may be a separate site and or a distinct site area with correspondingly distinct functions. Mitigation of this site can be expected to require considerable time, effort and funds.

41EP4720 (FB12430)

Elevation: 3,944 feet above mean sea level
Size: 6,130 square meters
Features: none

Site 41EP4720 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. In general, soils in the area of the site are fairly stable and vegetated with grasses and yucca. However, the site has been disturbed by military activity. A deep depression near the center of the site is modern and contains military refuse deposits.

Phase I reconnaissance investigations in the project area recorded a single isolated artifact in the site vicinity. Phase II investigators, working in closer survey interval transects, recorded the site as a moderate to low density scatter of

artifacts clustered mainly around a series of allthorn bushes. Small dunes are associated with many of the bushes, but these are not on the scale of dunes found in the western part of the Project 91-14 area.

Artifacts are generally associated with the deflated areas between the bushes and dunes. A small concentration of artifacts was also present about 30 meters north of the main concentration. A total of 560 artifacts was mapped on the surface of the site. The presence of El Paso Polychrome sherds on the site indicates an El Paso phase use of the locale.

The variety of artifacts suggests numerous activities and an extended period of occupation. Ceramic sherds are scattered along the eastern one-half of the site. The El Paso Polychrome sherds occur throughout this entire ceramic scatter suggesting that all the material may have originated from the same occupation. The western lobe of the site contains only burned caliche and fire-cracked rock on the surface, leaving the flake and ground stone artifact associated with the scatter of ceramics.

Artifact inventory:

Undifferentiated brownware sherd	29
El Paso Bichrome sherd	3
El Paso Polychrome sherd	4
El Paso Polychrome rim sherd	2
Debitage/chunk	1
Flake	415
Flake, utilized	14
Core	7
Core fragment	1
Flake, utilized	2
Hammerstone, angular	1
Hammerstone, rounded	1
Mano fragment	1
Other ground stone	5
Fire-cracked rock	4
Fire-cracked rock (uncollected)	3
Burned caliche	34
Burned caliche (uncollected)	34
Other lithic material	2
Total	563

The artifact variety and density in the relatively deep soils provide strong evidence for the presence of intact subsurface cultural deposits at the site. These same artifact characteristics suggest that cultural features are also present at the site. Surface evidence suggests that this site may provide evidence for broad research questions concerning settlement and subsistence strategies employed by the El Paso phase peoples, as well as evidence for more detailed studies concerning specific site functions and intrasite activities. Subsurface testing is a necessity for defining site limits and the extent of intact subsurface cultural deposits. Testing experience in similar landscapes within the Project 91-14 area indicates that cultural material may be buried to a depth of over 1 meter in these built-up sand areas.

41EP4721 (FB12431)

Elevation: 3,944 feet above mean sea level
Size: 3,650 square meters
Features: none

Site 41EP4721 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. Phase I reconnaissance survey recorded a single isolated artifact, and Phase II investigations recorded the site. This site is visible on the surface as a moderate to low density scatter of artifacts fairly evenly distributed across the site area. In general, soils in the area of this site are fairly stable and vegetated with grasses and yucca. No large mesquite-anchored coppice dunes are in the immediate vicinity of the site.

Most artifacts occurred in slightly deflated areas between low dunes, indicating that much of the site may remain buried under deposits of eolian sand. A total of 67 artifacts was mapped on the surface of 41EP4721. Two brownware sherds in the collection indicate a Formative period use of this locale.

Superficial examination of spatial relationships among artifacts provides little specific information, but there does appear to be a difference in activities across the site. Both sherds are located in the southern one-half of the site along with both utilized flake tools and five of the six pieces of flaked stone debris. Artifact types recovered from the north one-half of the site are restricted to burned caliche, fire-cracked rock, and other ground stone; all the pieces of other ground stone are fire-cracked. Lesser quantities of burned rock (burned caliche, fire-cracked rock and fire-fractured ground stone) also occur in the south half of the site. This distribution suggests more variety in the kinds of activities that occurred in the southern site area than in the northern part of the site. This perception may change, however, if subsurface testing is implemented.

Artifact inventory:

Undifferentiated brownware sherd	2
Flake	7
Flake, utilized	1
Other ground stone	8
Fire-cracked rock	5
Burned caliche	22
Burned caliche (uncollected)	22
Total	67

Subsurface testing is needed to determine the presence or absence of intact cultural deposits and for determining the limits of the site. This testing should also provide information concerning artifact and feature density and variety in sufficient detail to develop a research design for mitigation. The depths of sediments in the grassland area and the extant data concerning the relationship between surface cultural materials and buried cultural materials in this part of the project area suggest that significant cultural materials at this site are exceed what is suggested by the visible artifact density.

41EP4722 (FB12432)

Elevation: 3,947 feet above mean sea level
Size: 11,000 square meters
Area excavated: 41 square meters
Features: 1 pit structure
Dates: 3 ^{14}C

Site 41EP4722 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is on and around the perimeter of a large elevated area of eolian deposition and in a few shallow depressions. It is in a fairly stable, vegetated area with a few large mesquite-anchored coppice dunes in the vicinity of the site.

Phase I reconnaissance recorded the site as an isolated observation. The site was recognized as several surface scatters of ceramic sherds, flaked stone, ground stone artifacts, fire-cracked rock, and burned caliche. A total of 335 artifacts was mapped on the surface of Site 41EP4722. The presence of El Paso Polychrome and Chupadero Black-on-white indicates an El Paso phase occupation. Much of the site appears to be buried under deposits of eolian sand, with the portions in the eastern part more deeply buried than other areas.

Twenty-nine test units covering 41 square meters were excavated on Site 41EP4722. The units ranged in size from 1-by-1-meter squares to 2-by-2-meter squares. Testing revealed the presence of one small, shallow pit structure. Additionally, artifacts were recovered from several test units across the site, especially in the east-central part around the main datum. This area is covered with deep sand and some artifacts were recovered from depths of 50 to 60 centimeters below the present ground surface.

Feature 1 was a subrectangular pit structure located near the west edge of the site. This part of the site is deflated and a fairly dense surface artifact scatter was present on and around the feature. Military tank tracks went through the middle of the feature (east-west) and this disturbance may have contributed to the erosion of the area. The structure measured 2.10 meters

north-south by 2.05 meters east-west and was apparent immediately below the blow sand. The fill in the feature was about 20 centimeters deep but may have been greater before being deflated. The fill consisted of dark gray silty sand with abundant charcoal and daub. Several flaked stones, ceramic sherds, and ground stone artifacts were recovered from the fill. Feature 1 had been excavated into a natural caliche stratum that formed a distinct contact with the gray stained fill.

The floor of Feature 1 consisted of a rough surface of caliche portions, some of which had been compacted by tank traffic. The caliche floor was stained gray and had been disturbed in some places by rodent activity. It could not be discerned if the floor had been formally prepared. One El Paso Polychrome sherd, two ground stone artifacts, and a hammerstone were present on the floor near the eastern wall of the structure. One floor feature (Feature 2) was present in Feature 1.

Feature 2 consisted of a circular area of fine gray ash, charcoal, and burned caliche in the southeast corner of the pit structure. This feature was about 70 centimeters in diameter and 7 centimeters deep. A pocket of pure ash was present on the west edge of Feature 2 and the feature was surrounded by gray stained caliche and contained large chunks of burned clay or caliche near the center. One flake was recovered from within this feature.

Artifacts and Samples Inventory

Undifferentiated brownware sherd	29
El Paso Brown rim sherd	1
El Paso Bichrome sherd	3
El Paso Bichrome rim	2
El Paso Polychrome sherd	7
Chupadero Black-on-white	2
Unpainted plain	2
Debitage/chunk	11
Debitage/chunk, utilized	1
Flake	71
Flake, utilized	7
Bifacial retouch	1
Core	2
Hammerstone, angular	2
Hammerstone, angular fragment.	1
Hammerstone, rounded	1
Mano	1
Metate fragment	2
Mano/Metate fragment	1
Other ground stone	11
Fire-cracked rock	30
Burned caliche (uncollected)	102
^{14}C	30
Obsidian	1
Flotation	13
Other lithic material	1
Total	335

Scattered artifacts were present across much of the surface of Site 41EP4722 with no readily apparent differences in distribution between ceramic materials and stone artifacts. Small numbers of ceramic sherds were scattered across the site with two small clusters. One of these is in the deflated area around Feature 1 and the second, smaller cluster is in a small depression in the southeastern quadrant of the site. The only area lacking ceramics is the high ground in the east-central part of the site in an area that appears not to have been eroded, and artifacts recovered from test units in this area of the site were from farther below surface than in more deflated site areas.

Stone artifacts of one type or another cover almost the entire site with the exception of the uneroded east-central part. No pattern of stone artifact types is readily apparent from plot maps, but they do occur most often in association with deflated or otherwise eroded geomorphic features. Burned caliche and/or fire-cracked rock is present over much of the site and suggests the presence or at least former presence of several heat-related features. Flaked angular debitage also occurs over much of the site.

The number and variety of artifacts recovered from the site surface suggest that the prehistoric occupation evidenced here either represents a site of considerable size or a

number of overlapping small sites, or both. The structure suggests some longevity for site use, but no minimum time can be based simply on the presence of the structure. Several test units contained burned daub or adobe-like material similar to that recovered in considerable quantities from Feature 1. This certainly suggests that additional structures are present on the site. Artifacts were recovered from all these units to at least Level 4.

This site has the potential to address many of the questions raised in context statements and research questions developed by area researchers. It contains artifacts from which relative dates can be obtained, and it contains features with datable carbon and intact subsurface deposits. The site can address questions concerning periods of use of the transition zone, the desert floor, and the mountain alluvial fan interface, as well as subsistence and settlement issues and questions related to site types and functions through time. This site has the potential to yield archaeological data from intact deposits and features. It is therefore recommended that future archaeological research should include a data recovery or mitigation program.

Mitigation plans should address the single large site versus multiple small overlapping site issue, particularly as this issue must be more thoroughly understood before other questions concerning land use and site function can be addressed. A small number of additional test units may provide evidence for separating the small cluster of materials from the rest of the site. Block excavations are recommended in the vicinity of the test units from which the burned clay and/or daub was recovered. Intact subsurface cultural deposits were present in each of these units and artifact quantities were generally higher in these units.

Additional testing on the north and east side of the site with units placed beyond these boundaries is necessary because time constraints prevented the completion of the original testing program. Currently completed test units do not extend far enough north to test the northern end of the site for subsurface artifacts. Test units have extended to or near the eastern extent of surface artifacts, but these easternmost units all yielded subsurface artifacts indicating that the site probably extends beyond the currently defined eastern boundary. Intact subsurface deposits with few, if any, surface artifacts indicate this extension.

41EP4723 (FB12433)

Elevation: 3,948 feet above mean sea level
Size: 170 square meters
Area excavated: 9 square meters
Features: none

Site 41EP4723 (Figure A.5) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern-central part of the Tobin Well project area in Fort Bliss Maneuver Area I. This site is situated in a depression surrounded by elevated areas of eolian deposition. The area is fairly stable and vegetated, with no large mesquite-anchored coppice dunes near the site. Phase I reconnaissance survey recorded the site. The surface of the site consisted of a concentration of ceramic sherds, flaked stone, ground stone artifacts, fire-cracked rock, and burned caliche. Subsurface investigations showed that intact subsurface cultural deposits are present at the site, but apparently not in high density. A total of 43 artifacts was mapped on the surface, and an additional 10 artifacts were recovered from the test units. The presence of ceramic artifacts indicates at least a Formative period occupation.

Excavation of nine test units encountered no subsurface features. However, ten subsurface artifacts were recovered from units spread across the site area as defined by the surface distribution. It appears that the central part of the site in the deflated area is highly eroded, but artifacts remain in good context immediately below surface beyond the most severely deflated area of the site.

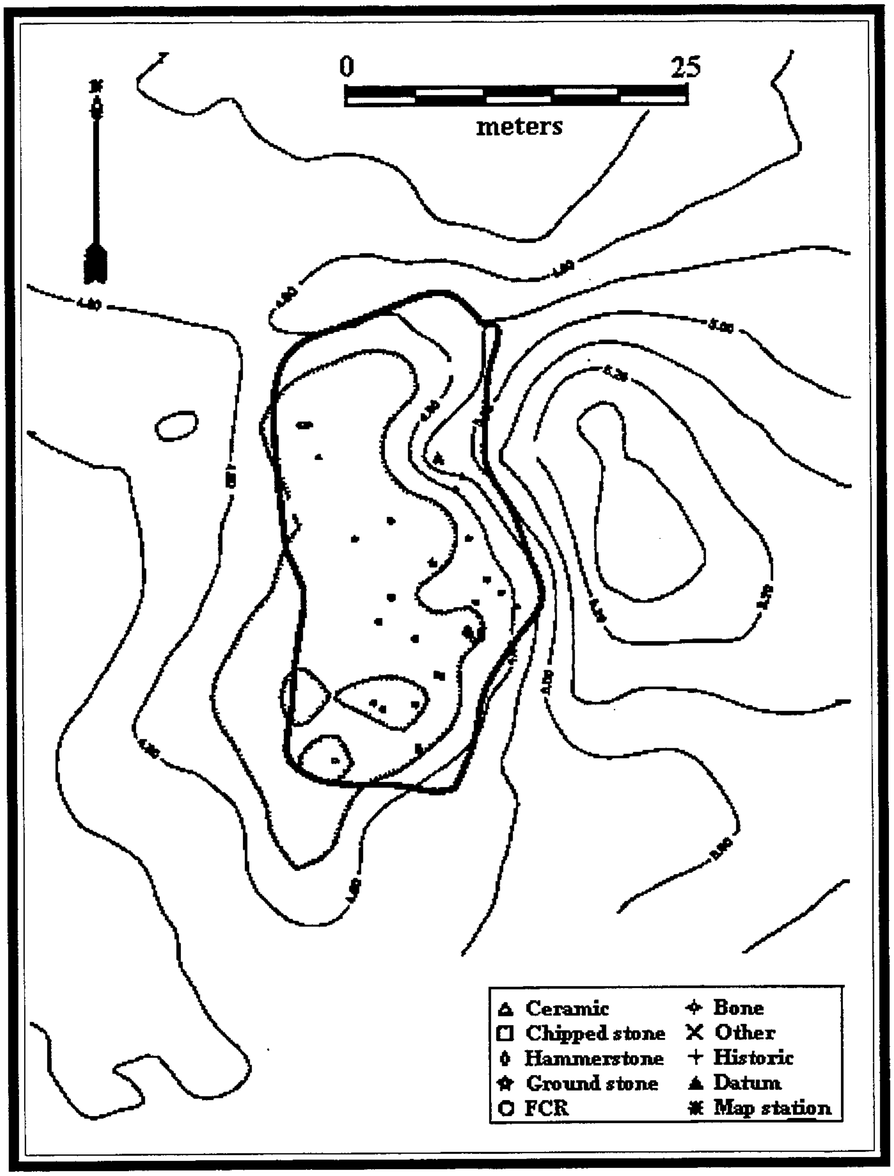

Figure A.5. Site 41EP4723

Artifacts and samples inventory	
Undifferentiated brownware sherd	2
El Paso Bichrome sherd	1
Debitage/chunk	1
Flake	3
Mano/metate fragment	1
Other ground stone	10
Fire-cracked rock	8
Fire-cracked rock (uncollected)	1
Burned caliche (uncollected)	16
Total	43

Artifacts were recovered from test Units 1, 3, 4, 5, 6, and 9. Units 1 and 3 each contained a single artifact from level one. Unit 4 contained a single artifact from Level 2 and a flake from Level 7. Unit 5 contained a single artifact from Level 6. One artifact was recovered from Level 4 of Unit 7 and four artifacts were recovered from Level 6 of Unit 9. This indicates that intact cultural deposits remain outside the most severely eroded center of the site.

A cursory examination of artifact distributions over the site surface by basic artifact type provides little information concerning spatial patterns. Ceramic sherds are few and scattered across the central part of the site. Stone artifacts are generally present across the southern two-thirds of the site with little to suggest multiple distinct activity areas, rather the material appears to be the scattered remnants of a hearth or other heat-related feature.

Artifact densities are low, but this is not uncommon on sites away from villages in the region. This site is of value because it contains diagnostic artifacts and the possibility of more precisely datable materials, particularly carbon. The presence of carbon is suggested by the fire-cracked rock recovered both on and below the surface.

Although the artifact density at the site is not high, the collection does contain considerable diversity. This suggests multiple types of site activities and the likelihood of cultural features. This diversity of artifacts and datability make the site of use in addressing a number of research questions that have been posed for the prehistory of the bolson. Recommended archaeological research on the site includes investigation of small blocks in the undeflated positions of the site. Limited backhoe trenching at the site is probably the best means of locating subsurface features.

41EP4724 (FB12434)

Elevation: 3,935 feet above mean sea level
Size: 1,170 square meters
Features: none

Site 41EP4724 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is just to the northeast of the existing missile facility. The surface of this site slopes to the east with drainage towards a playa some 110 meters to the northeast. Generally, soils in the area are stable and vegetated with grasses and yucca. However, two large mesquite-anchored coppice dunes and an interdunal deflation are near the southeast edge.

Phase I reconnaissance investigations described the site as less than 50 square meters in area and recorded a brownware sherd and other burned caliche and fire-cracked rock. Phase II investigators described it as a moderate to low density scatter of artifacts clustered in deflations within a large dune field on the western edge of the grassland. Most artifacts occurred in slightly deflated areas, indicating that much of the site may remain buried under deposits of eolian sand. A total of 62 artifacts was mapped on the surface. The presence of four undifferentiated brownware sherds indicates a possible Formative period occupation.

The general distribution of surface artifacts indicates two distinct clusters, one in the northwest corner of the site and the second covering approximately the southern one-half of the site area. However, the separation of artifact clusters may result more from differential exposure resulting from erosion and deflation than from discard patterns. The latter is suggested by the existence of a topographically higher landform that lies between the two clusters and on which only a single artifact was found.

Ceramic sherds were all concentrated in the southern cluster, suggesting their origin may have been a single vessel. Burned rock (burned caliche and fire-cracked rock) occurred within both clusters and the flaked stone collection showed no readily apparent pattern beyond the artifact clusters. Both pieces of ground stone are in the southern artifact cluster; both are fragmentary and may be thermally altered.

Artifact inventory

Undifferentiated brownware sherd	4
Debitage/chunk	11
Flake	7
Core fragment	1
Metate fragment	1
Other ground stone	8

Fire-cracked rock	5
Burned caliche (uncollected)	25
Total	62

The relatively low quantity of artifacts on the site surface suggests short-term use, but the variety of artifact types indicates a number of distinct activities and may be evidence for the site being considerably more than it appears at the surface. Although no features are visible, the widespread presence of burned caliche and fire-cracked rock indicates the previous existence of heat-related features. It is likely, given the apparent depth of sediments over much of the site area, that such features still exist, intact, below the present ground surface.

Subsurface testing is needed at this site to determine the site's horizontal limits and the quantity and quality of subsurface cultural deposits. The variety of artifacts on the surface indicates the site is a good candidate for providing carbon for dating and for investigating settlement and subsistence related research questions for the area. The artifact variety may also be of value in investigations concerning site types and functions in the Hueco Bolson and for investigating intrasite activity patterns.

41EP4725 (FB12435)

Elevation: 3,935 feet above mean sea level
Size: 1,960 square meters
Features: 1 stain

Site 41EP4725 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is just east of the northeast corner of the existing Hawk Missile facility. About half of the northern part of the site consists of deep deposits of eolian sand. In general, soils in the area are stable and vegetated with grasses and yucca. One large mesquite-anchored coppice dune is present on the western margin of the site.

Phase I reconnaissance survey of the project area described the site as a small scatter of artifacts in an area of less than 50 square meters. The more intensified survey strategy employed in Phase II investigations showed the scatter to be larger than originally defined but failed to find the number and variety of materials originally defined within the small area.

The site consists of a single feature and seven artifacts in a series of three deflations and a built-up dunal area. Artifacts consist of three pieces of flaked stone debitage, two pieces of ground stone, one utilized flake, and one El Paso Polychrome sherd. The polychrome sherd indicates a time of site use during the El Paso phase. All the artifacts occurred in deflations, indicating that much of the site may remain buried under deposits of eolian sand.

Feature 1 consists of a 50-centimeter-diameter dark gray stain in the bottom of a depression in the southwest corner of the site. No fire-cracked rock or burned caliche was found in the feature stain, but two pieces of ground stone were recovered nearby. Modern trash in the area indicates the possibility that the feature may not be prehistoric.

The variety of artifacts visible on the surface at this site indicates that several site activities are represented and this suggests there are considerably more artifacts present than are on the surface. The visible artifacts are in areas such as blow outs and slopes where erosion is apparent. Even these areas of the site retain what appears to be a considerable thickness of eolian sands; however, it is quite likely that most of this site remains intact beneath the current land surface. Investigation of artifact patterns with so few artifacts is probably of little use within the site limits.

Artifact inventory:

El Paso Polychrome sherd	1
Debitage/chunk, utilized	1
Flake	2
Flake, utilized	1

Other ground stone	2
Total	7

As a surface manifestation, Site 41EP4725 does not appear to be significant, but evidence from subsurface testing of other sites in the vicinity suggests that in the built-up sands, surface artifacts provide little evidence of site significance other than to serve as a locational tool. The stain visible at the site indicates that the site has the likelihood of providing datable carbon, as well as time-diagnostic artifacts. The variety of artifacts suggests that site function can also be addressed with further investigations. Subsurface testing should provide the necessary information to gauge the quantity and quality of expected intact subsurface cultural materials.

41EP4726 (FB12436)

Elevation: 3,945 feet above mean sea level
Size: 1,100 square meters
Features: none

Site 41EP4726 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. In general, the soils in the area are vegetated with grasses and yucca. No large mesquite-anchored coppice dunes are present in the vicinity of this site.

Phase I reconnaissance survey of the project area did not record this site but, through a more intensive survey during Phase II, the site was discovered. The site consists of ten artifacts, including fire-cracked rock, burned caliche, and flaked stone debitage, that were widely dispersed over an area of stable eolian sands. No temporally diagnostic artifacts were present on this site and no period of occupation can be determined. Most of the artifacts occurred in slight depressions indicating that much of the site may remain buried under eolian sand.

Artifact inventory:

Debitage/chunk	1
Flake	3
Fire-cracked rock	5
Burned caliche (uncollected)	1
Total	10

The few artifacts noted on the surface of this site show no readily apparent patterns; flaked stone and burned rock occur across the site. The burned caliche and fire-cracked rock on the site surface probably indicate former hearths or other heat-related features. This site is covered by significant deposits of eolian sands, and it is likely that intact buried cultural deposits remain. Subsurface testing is needed to determine site limits and the quantity and quality of these cultural deposits. Until such testing is conducted, little else can be said about this small artifact scatter.

41EP4727 (FB12437)

Elevation: 3,945 feet above mean sea level
Size: 2,055 square meters
Features: none

Site 41EP4727 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. Approximately half of the site area is covered with dunes and eolian sand deposits indicating that portions of the site may remain buried.

Phase I reconnaissance survey recorded the site as a series of four isolated observations. The more intensified survey efforts of Phase II discovered several additional artifacts and upgraded the scatter to site status. The site consists of 20 artifacts widely dispersed throughout the surface of several depressions around large mesquite-anchored coppice dunes. These artifacts included fire-cracked rock, burned caliche, and flaked stone debitage. No temporally diagnostic artifacts were present on this site and no period of occupation can be determined at the present time.

Flaking debris and burned rock are scattered throughout the site with no indication

of clustering by artifact type. The limited variety of artifacts visible on the surface suggests that the site was short-term in use and that the variety of activities was quite limited. This region of the project area is covered with significant depths of eolian sands and subsurface testing in the vicinity of this site indicates that surface visible cultural materials may not provide a good assessment of the underlying cultural deposits. Burned caliche and fire-cracked rock on the surface indicate that hearth(s) or other heat-related features were present on the site and that the site is likely to produce datable carbon. Subsurface testing is needed to determine site limits and quantity and quality of expected subsurface cultural materials.

Artifact inventory:

Flake	5
Fire-cracked rock	2
Burned caliche	1
Burned caliche (uncollected)	12
Total	20

41EP4728 (FB12438)

Elevation: 3,945 feet above mean sea level
Size: 1,460 square meters
Area excavated: 22 square meters
Features: none

Site 41EP4728 (Figure A.6) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the east-central part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is bisected by a bladed road that has apparently been in existence for some time. This site is situated in a fairly stable, vegetated area with no large mesquite-anchored coppice dunes in the immediate vicinity. Nearby built-up sands are considerably deep and much of the site appears to be buried under these dunal deposits.

Phase I reconnaissance survey did not record the site, which consisted of a scatter of flaked stone and ceramic artifacts, fire-cracked rock, and burned caliche dispersed almost entirely along the deeply cut roadbed. A total of 33 artifacts was mapped on the surface. The presence of brownware sherds on the site indicates at least a Formative period use.

Sixteen excavated test units were evenly spread across the site with one test unit within each 10-meter square block. The horizontal limits of the initially planned units were restricted to the vicinity of visible surface artifacts. Some additional units were excavated outside this initial area when artifacts were recovered from subsurface contexts in units on the outer limits of the original grid.

No features were encountered in the test units but nineteen subsurface artifacts were recovered. These materials were recovered from test Units 2, 3, 5, 6, 7, 11, 12, 13, and 15. A few artifacts were recovered from the southeastern part of the site in an area of high sands. Four artifacts were recovered from a depth of 60 to 70 centimeters below the surface and one artifact was recovered from a depth of 50 to 60 centimeters below surface.

Artifact and sample inventory:

Undifferentiated brownware sherd	8
Debitage/chunk	4
Flake	13
Metate fragment	1
Other ground stone	4
Fire-cracked rock	13
Fire-cracked rock (uncollected)	2
Burned caliche	5
Total	50

Artifacts recovered from test units tend to cluster 5.30 to 5.40 meters below datum suggesting that the original occupation surface was not as varied topographically as the present site surface. Artifact density is generally low and distribution is sporadic. It is probable that this site is similar to many of the sites in the dunal part of the project area, but not as visible on the surface because of the eolian sand deposits. Artifacts may represent multiple overlapping or nearly overlapping sites, but additional investigations are needed to make such a determination.

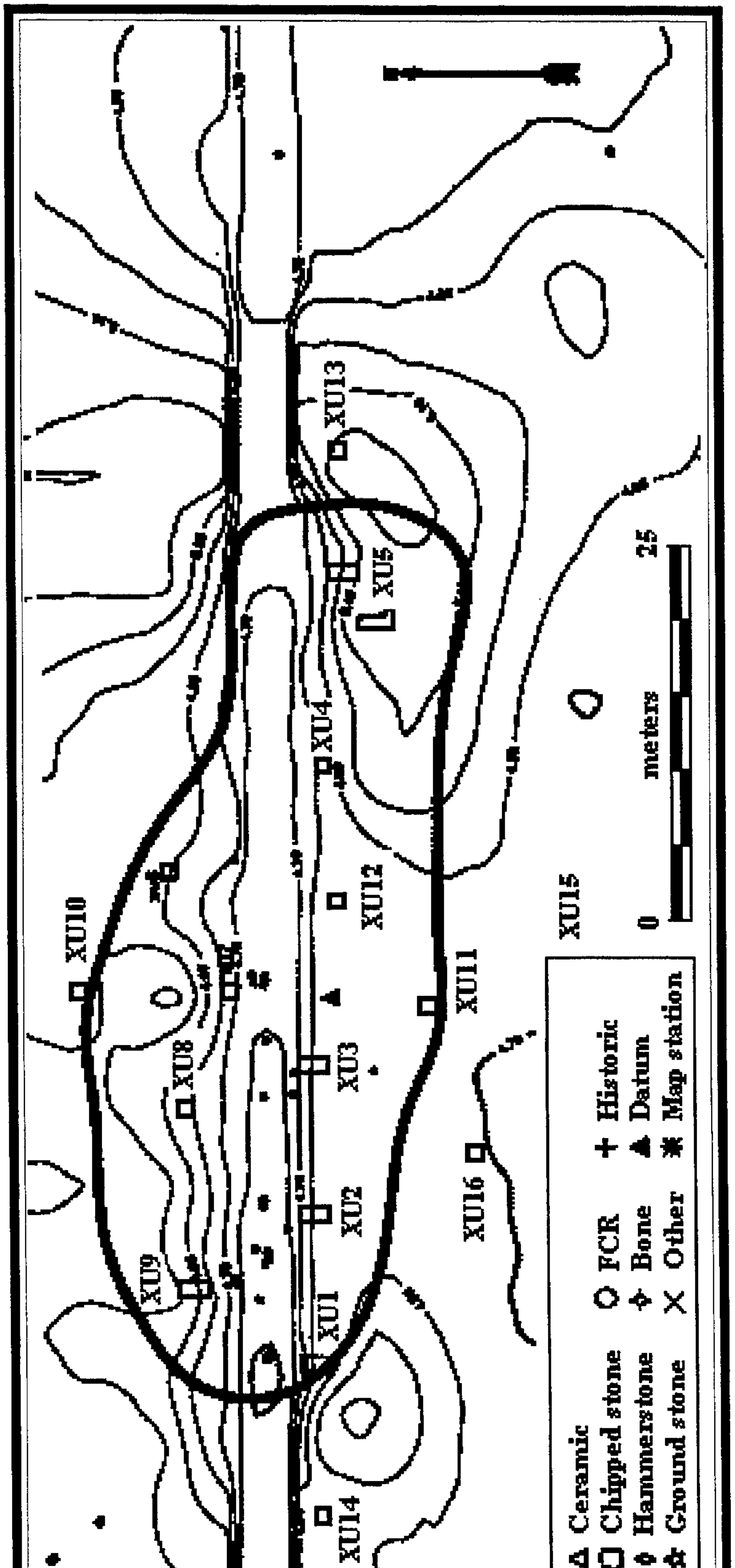

Figure A.6. Site 41EP4728

Soil stratigraphy in some excavation units included an old A soil horizon that may be traceable to other A horizons in the desert floor and alluvial fans, and possibly be dateable. Artifacts recovered from units containing this soil horizon were always recovered from below the horizon, relatively dating them to pre-A horizon formation.

The number of artifacts recovered from the site is low, but there is considerable diversity in the collection. Activities associated with the artifact types probably include flaked stone tool production, food processing, and other camp-related activities. Fire-cracked rock and burned caliche indicate the presence of heat-related features. There is a minor variation in the location of lithic and ceramic artifacts with lithic materials concentrated in the west end of the site and extending to the middle of the site while ceramic sherds are most common in the middle of the site. This distribution should be viewed with considerable caution, however, in terms of site activity interpretation, as the distribution may be the result of road grading and not the original place of deposition.

Site 41EP4728 was found after road grading had cut far enough below surface to reveal buried cultural materials. Just two artifacts were visible on the site surface within the currently defined site limits, which are not on the bladed road. The site area is characteristic of much of the grassland-built-up sand area of the project in that artifacts visible on the surface may have little relevance to cultural materials present below surface.

The site is datable in relative terms by the ceramic sherds recovered from its surface and may well be more precisely datable through other means with further investigations. The quantity of burned rock on the site suggests the former presence of fire and resulting carbon at the site, and it is possible that carbon can be recovered in sufficient quantity for ^{14}C dating.

The ability to place this site within a historic context makes it valuable as a source of information concerning subsistence and settlement strategies. The numbers and varieties of artifacts are sufficient to address site function and site-related activities. Further investigations are warranted at this site to mitigate adverse affects related to use of this area.

41EP4729 (FB12439)

Elevation: 3,940 feet above mean sea level
Size: 160 square meters
Area excavated: 15 square meters
Features: 1 fire-cracked rock scatter

Site 41EP4729 (Figure A.7) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the southeastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is in a fairly stable, vegetated area with a few large mesquite-anchored coppice dunes in the immediate vicinity. The site lies along an existing bladed road.

Phase II investigations recorded the site as a scatter of flaked stone and ceramic artifacts, fire-cracked rock, and burned caliche dispersed along the deeply cut roadbed. A total of 51 artifacts was mapped on the surface, none of which were found outside the roadbed. No temporally diagnostic artifacts were present on this site, and a period of occupation cannot be determined at the present time. Much of the site and surrounding area appears to be buried under deposits of eolian sand.

Eleven test units were excavated on Site 41EP4729 covering an area of 14 square meters. The units were spread across the site area identified by the surface distribution of artifacts in the road. Three units (9, 10, 11) were placed in the peripheral areas of the site after initial excavations revealed subsurface cultural materials, thus indicating that the site extended to the north and south beyond the road. No subsurface features were encountered in the test units, but 61 artifacts were recovered. Several pieces of fire-cracked rock and flaked stone artifacts were recovered on the south side of the road above

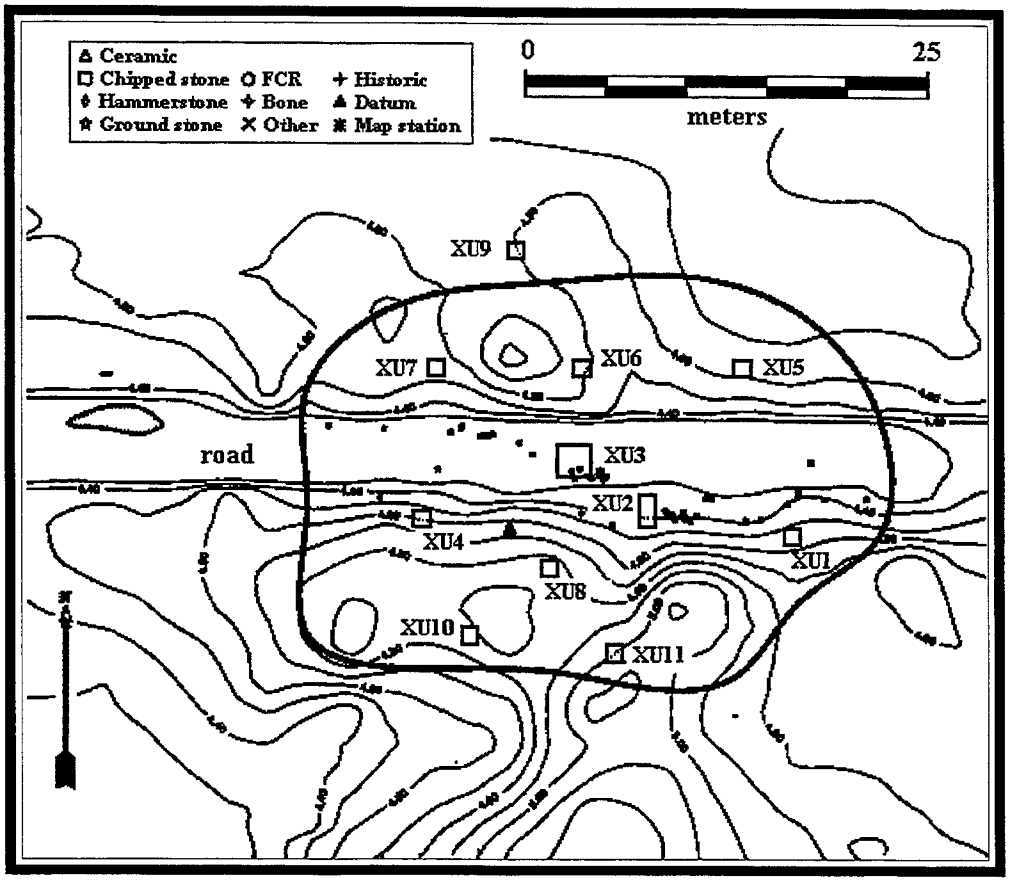

Figure A.7. Site 41EP4729

Feature 1. The feature was a scatter of fire-cracked rock on the surface of the road.

Units 2, 3, 4, 6, 8, 10, and 11 yielded artifacts from below surface. The depth below surface from which artifacts were recovered varied considerably, but the depth below datum remained constant. Artifacts consistently occurred in the 5.60–5.70 meter elevation range (datum arbitrarily occupied at 5.00 meters elevation and increasing with depth). The distribution of cultural materials at a consistent absolute elevation suggests strongly that they resulted from a single site use episode. Such observation is supported by the lack of stratigraphic soil evidence indicating either a period of deflation, which would have collapsed artifacts from multiple occupations on a single surface, or a stable surface at that elevation on which multiple occupation surfaces could have accumulated. It is possible that more than a single occupational episode is represented, but there is no supporting evidence.

Feature 1 consisted of a dispersed scatter of 12 pieces of fire-cracked rock in the bottom of a deeply cut roadbed. A 2-by-2 meter unit was placed over the feature and the blow sand was brushed off. This feature proved to have no associated stain and did not extend below the roadbed. The fire-cracked rock that comprised this feature may have eroded into the roadbed from contexts to the north or south of the road. Four flaked stone artifacts and one ground stone artifact were recovered from the excavation of this feature.

Artifact and sample inventory:

Debitage/chunk	22
Flake	11

Metate fragment	1
Other ground stone	3
Fire-cracked rock	37
Total	74

The artifact collection from 41EP4729 is somewhat remarkable in the unusually large number of pieces of flaked stone. The particularly high percentage of debitage/chunks suggests that lithic reduction and/or flaked stone tool production was a particularly apparent on-site activity. Broken ground stone suggests grinding activities, but this material may also have been utilized as hearth stone. Fire-cracked rock is common and the cluster of cultural material recorded as Feature 1 contains a considerable quantity of fire-cracked rock, which indicates the presence of a hearth. This is what Feature 1 was originally believed to be, but excavations suggest that this is not the actual location of a feature, but simply an artifact cluster. The feature may remain in the undisturbed sands along the sides of the road or may have been destroyed during the grading process.

The artifact distribution suggests the site is the remnants of a short-term occupation with a limited horizontal expanse. It is likely that most, if not all, of the original site area is contained within the site limits. Test excavation of Unit 3 indicates that intact deposits no longer remain in the road, but test units in the sands along either side of the road documented intact deposits. The site is expected to yield information concerning lithic reduction strategies employed by prehistoric peoples and may well be datable in absolute terms by carbon if the heat-related feature indicated by the fire-cracked rock remains at least partially intact in the built-up sands.

Mitigation procedures at this site should include block excavations along both sides of the road concentrating in the vicinity of the test units that produced the most artifacts. The lessening in artifact density away from the central site area (as shown by artifact counts from test units and by the distribution of artifacts on the road surface) indicates that this part of the site is certain to be the most productive in terms of the density of prehistoric cultural evidence.

41EP4730 (FB12440)

Elevation: 3,942 feet above mean sea level
Size: 500 square meters
Area excavated: 29 square meters
Features: none

Site 41EP4730 (Figure A.8) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the southeastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. This site is situated in a small depression surrounded by areas of high eolian sands. Within the project boundary it is located in the grasslands. No large mesquite-anchored coppice dunes are present in the immediate vicinity of the site.

Site 41EP4730 was not recorded during the Phase I reconnaissance survey, which used 15-meter-wide survey transects. Cultural material visible on the surface included a scatter of fire-cracked rock, burned caliche, ground stone, and debitage. Eight artifacts were mapped. No temporally diagnostic artifacts were present on this site and a period of occupation cannot be determined at this time.

Ten excavated test units varied considerably in size but were scattered across the site surface in a manner intended to thoroughly test the entire site area. Unit distribution was designed to test the variety of topographic features on the site (e.g., blowout, built-up sand). No subsurface features were encountered, and only 18 artifacts (13 of which were burned caliche) were recovered from the subsurface. It appears that the majority of the site has been deflated. Eleven of the 18 artifacts were from one unit and all of these were from the loose blow sand of Level 1. These artifacts are not believed to be in original context. Lesser numbers of artifacts were found in other units in what is apparently good context, but the main part of the site ap-

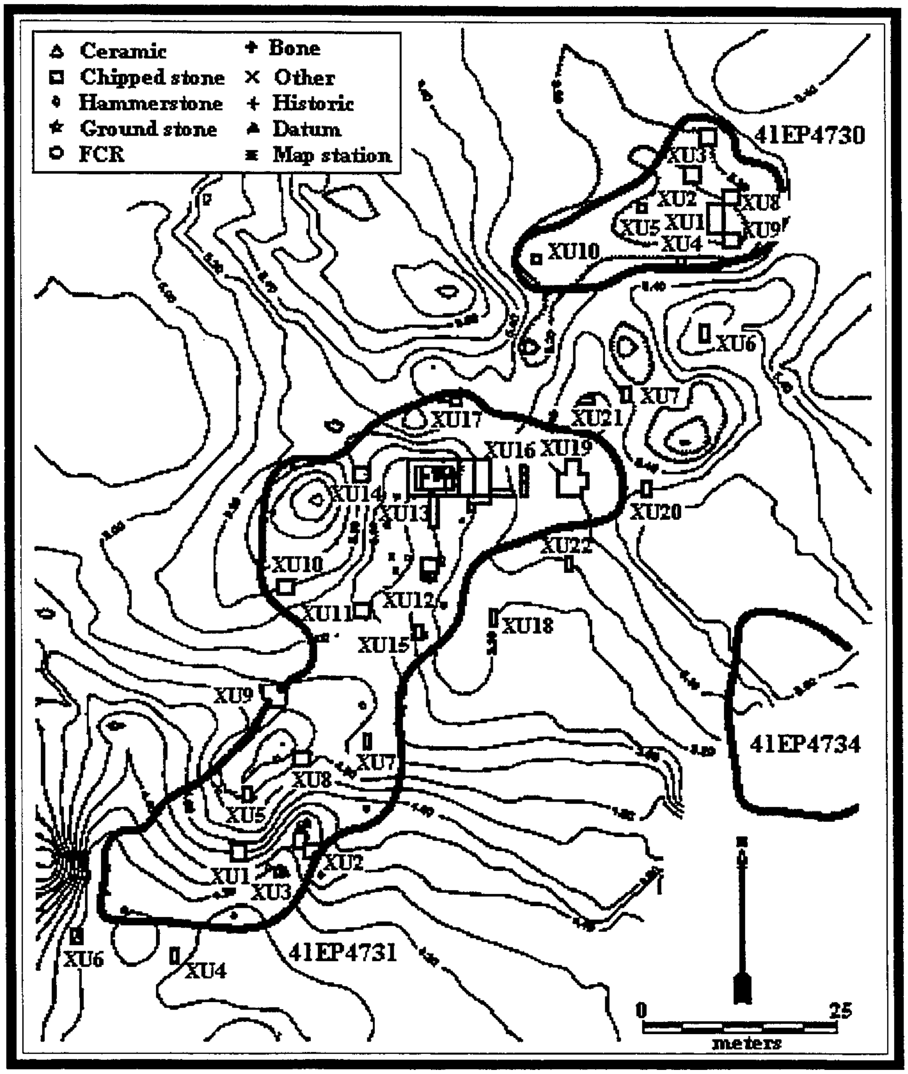

Figure A.8. Sites 41EP4730 and 41EP4731.

pears to have been completely eroded. The only intact subsurface artifact other than very small pieces of burned caliche is a flake recovered from Unit 3, Level 3.

Artifact and sample inventory:

Flake	3
Debitage/chunk	1
Metate fragment	1
Other ground stone	2
Fire-cracked rock	1
Burned caliche	12
Burned caliche (uncollected)	5
Total	25

Artifact variety from the site is limited and suggests that the site functioned as a short-term camp or location with a limited variety of activities. The recovery of only three pieces of flaked stone in excavations covering 29 square meters indicates that lithic reduction was a very limited activity if it occurred on site at all. It is entirely possible that these materials were brought to the site ready made. Ground stone is all fragmentary and may have functioned last in the context of hearth rocks rather than as grinding implements. Fire-cracked rock and burned caliche indicate the former existence of a heat feature,

but testing evidence suggests that the feature has been completely eroded.

The site is not datable currently and results of current investigations suggest little evidence that datable materials remain at this site. Artifact quantities are so low in units where they occurred in good context that it is unlikely that further investigations will add significantly to the information obtainable from the site. Therefore, no further archaeological investigations are recommended for 41EP4730.

41EP4731 (FB12441)

Elevation: 3,940 feet above mean sea level
Size: 1,675 square meters
Area excavated: 143 square meters
Features: 4 stains
Dates: 3 ^{14}C

Site 41EP4731 (Figure A.8) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the southeastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. It is in a fairly stable, vegetated area with only a few large mesquite-anchored coppice dunes.

Phase I reconnaissance survey recorded the site as two isolated observations. It is relatively large and extends across various topographic features including a small rise into adjacent drainages. At the surface, the site is visible as a scatter of flaked stone and ceramic artifacts, fire-cracked rock, and burned caliche. A total of 41 artifacts was mapped on the surface. The presence of ceramic artifacts on the site indicates at least a Formative period occupation. Radiocarbon dates verify this and also indicate an earlier pre-Formative occupation. Much of the site and surrounding area is buried under deposits of eolian sand.

The isolated observations recorded during the 1991 reconnaissance survey were located in the drainage in the southeastern part of the site as it is currently defined. During the attempted relocation of these isolated finds, additional artifacts were found in the southern part of the site and resulted in the discovery of additional cultural materials scattered north along the drainage to a small cluster in the north-central part of the site. Site limits were determined by the distribution of surface artifacts. Testing began at the southern end of the site in the immediate vicinity of the first recorded artifacts and proceeded to the north.

Excavation of 22 test units covering an area of 143 square meters revealed the presence of four subsurface stains in the northeastern part of the site. Additionally, subsurface artifacts were recovered from most units in this area. Much of the site area is covered with deep eolian deposition and cultural materials were encountered as deep as 80 centimeters below the present site surface. Future archaeological research recommendations include extensive additional testing in areas of built-up sand, especially in the northern part of the site.

Feature 1 was a diffuse, light gray stain with a few charcoal flecks. This stain, which was about 1.5 meters in diameter and approximately 15 centimeters thick, was situated immediately below the blow sand and 10 centimeters below the present site surface. Artifacts associated with Feature 1 consisted of flaked stone items, ceramic sherds, ground stone fragments, fire-cracked rock, and burned caliche. One obsidian projectile point base was also associated with the feature. The base is dart point size and may be of pre-Formative period origin. An extended-count radiocarbon date on charcoal recovered from this feature will provide substantiating evidence for feature age. Fifty-five items were collected from the excavation of Feature 1, which may represent the eroded remains of a hearth.

Feature 2 consisted of another diffuse, light gray stain with a few charcoal flecks. This stain was 1.6 meters in diameter and 20 centimeters thick. A darker stain was present near the center of the feature. In profile, Feature 2 was basin-shaped and was situated under approxi-

mately 20 centimeters of blow sand. Artifacts associated with the stain consisted of flaked stone items, ceramic sherds, ground stone fragments, fire-cracked rock, and burned caliche. Approximately 65 items were collected from the excavation of this feature. Like Feature 1, this stain may represent the eroded remains of a hearth. An uncorrected radiocarbon age of 1260 ± 70 B.P. (Beta 58421) was obtained from charcoal recovered from this feature.

Feature 3 consisted of a dark gray stain with charcoal flecks. This stain was about 1 meter in diameter and 15 centimeters thick. A few pieces of burned caliche and oxidized soil were present. The stain was basin shaped in profile and began at a depth of 63 centimeters below the present site surface. Artifacts associated with this stain consisted of flaked stone and ceramic items, ground stone fragments, bone fragments, fire-cracked rock, and burned caliche. Approximately 300 artifacts and samples were collected from the feature. Feature 3 may represent the remains of a hearth. Two charcoal samples from the feature were radiocarbon dated (uncorrected) to ages of 2210 ± 80 B.P. and 2260 ± 80 B.P. (Beta 58422 and Beta 58423, respectively). Examination of artifact distribution by level for the 1-by-1-square-meter units that include parts of Feature 3 provide strong evidence that the two ceramic sherds recovered from the feature were present through bioturbation and/or erosional processes rather than through primary deposition. Ceramic quantities are higher in the levels above Level 4 than in Level 4 and no ceramics exist below this level even though lithic artifact counts generally increase below this level. The evidence strongly suggests that this part of the site is made up of multiple vertical components and that this feature originated from a pre-Formative component, while features excavated in Unit 13 originated from a later Formative period component that extended into the vicinity of Feature 3, but overlies it.

Feature 4 was also a dark gray stain with charcoal flecks located about 2 meters north of Feature 3 and at the same depth. This stain measured approximately 50 by 75 centimeters and was about 10 centimeters thick. Artifacts associated with the feature consisted of flaked stone items, ceramic sherds, ground stone fragments, fire-cracked rock, and burned caliche. A total of 120 artifacts and samples was collected. Feature 4 may also represent the remains of a hearth. The age of origin for this feature is unknown, but extended-count radiocarbon dates on charcoal recovered from the feature should provide period of origin information. The feature contains more ceramics to greater depth than the nearby Feature 3 and may be later in origin. Its close association with Feature 3 and the nearly identical depth of the feature, however, suggest that the feature is of pre-Formative period age and that the ceramics and other materials present in its upper levels are likely included as a result of erosion and/or bioturbation rather than having been directly deposited in the feature.

Artifact and sample inventory:

Undifferentiated brownware sherd	74
Unpainted plain sherd	4
Debitage/chunk	81
Tested pebble	1
Flake	62
Flake, utilized	2
Projectile point	2
Core	10
Hammerstone, rounded fragment	1
Other ground stone	29
Fire-cracked rock	65
Burned caliche	4
Bone, nonhuman	7
Shell	2
^{14}C	30
Other	1
Total	375

Site 41EP4731 is a relatively large and complex site that exhibits strong evidence for multiple cultural components. These components are apparently stratified both horizontally and vertically. The clustering of artifacts across the site surface and varying density of cultural

material from test units suggest at least two horizontal components. However, disparate radiocarbon dates from features on the north end of the site and variation in artifact type distribution with depth in the vicinity Feature 3 indicate multiple vertical components.

Artifacts were recovered from subsurface context in Units 2, 3, 5, 6, and 9, which were in and around the southern artifact cluster. No ceramic sherds were recovered from this southern cluster, either from surface collection or from subsurface context. It is probable that the southern end of the site represents a separate occupation from the northern end.

The northern end of the site is complex because of vertical components. The definition of these components is not entirely possible at this time, but can be expected to be more readily identifiable with the availability of forthcoming extended-count radiocarbon dates from features one and four.

Additional excavation is needed in the northern end of this site. A substantial amount of work has already been completed, but further work with excavation carefully controlled vertically is expected to provide artifacts from two vertical components and tie in cultural material from test units such as Units 12 and 18 with specific vertical components recognized in Unit 19 and possibly present in Unit 13.

41EP4732 (FB12442)

Elevation: 3,939 feet above mean sea level
Size: 80 square meters
Area excavated: 14 square meters
Features: 1 stain

Site 41EP4732 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the southeastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. This site is situated in a stable vegetated area with only a few large mesquite-anchored coppice dunes.

Site 41EP4732 was recorded as a single isolated observation during the 15-meter-wide transect reconnaissance survey of Phase I. The surface manifestation of the site consisted of a scatter of fire-cracked rock, burned caliche, and debitage. Fifteen artifacts were mapped on the surface. No temporally diagnostic artifacts were present, and a period of occupation cannot be determined. Much of the site and surrounding area appear to have been disturbed by mechanical grading and other army activities. Evidence for this is present in the form of both built-up dunal deposits and in a circular depression located just east of Unit 1. One of the apparently artificial "dunes" is visible as the high area bounded by the 4.90-meter contour interval in the northwest part.

Three test units were excavated on Site 41EP4732. One subsurface stain with minute amounts of charcoal was encountered in the southwest part of the site (within Unit 1). However, this stain might have been the result of military activity and was not assigned a feature number. The stain was just to the north of a small mound of sand believed to have been excavated during U.S. Army activities from the depression just east of the unit. No artifacts were recovered from below surface in this test unit.

Seven artifacts were recovered from the thin layer of blow sand in Units 2 and 3 in the northern part of the site, but there was no evidence suggesting intact subsurface cultural deposits.

Artifact and sample inventory:

Debitage/chunk	1
Flake	1
Flake, utilized	1
Other ground stone	1
Fire-cracked rock	12
Burned caliche	4
Burned caliche (uncollected)	7
^{14}C	1
Flotation	1

Pollen	1
Total	30

The distribution of artifacts on the surface suggests a single activity locus apparently in the vicinity of a hearth or other heat-related feature. Stone artifacts of various types make up the entire surface collection.

This site appears to have been highly eroded and significantly disturbed by military activity. No further archaeological research is recommended for this site.

41EP4733 (FB12443)

Elevation: 3,933 feet above mean sea level
Size: 560 square meters
Features: 1 Fire-cracked rock and/or burned rock feature

Site 41EP4733 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the central part of the Tobin Well project area in Fort Bliss Maneuver Area I. A two-track military trail road runs through the site. The site is visible on the surface as a single fire-cracked rock and burned caliche feature and a scatter of other artifacts.

Phase I reconnaissance survey originally recorded the site. The cluster of materials in the south-central part of the site is Feature 1. Twenty-two artifacts distributed within the limits of a single depression between large mesquite-anchored coppice dunes consisted of fire-cracked rock, burned caliche, ground stone, and flaked stone debitage. No temporally diagnostic artifacts were found on this site, possibly due to decades of relic collecting in the project area, and no period of occupation can be determined from the present investigation. Some cultural materials may remain buried under eolian sands around the perimeter of the site.

Feature 1 consists of a 75-centimeter-diameter cluster of two pieces of fire-cracked rock and eight pieces of burned caliche. No stain was observed within the feature area. This feature appears to be highly deflated and has little potential for radiocarbon dating.

The rather linear arrangement of artifacts on the site probably is the result of disturbance from the traffic on the two-track road in which most of the artifacts lie. The feature appears to be too deflated to provide datable carbon, and the site area in its immediate vicinity appears to also be considerably eroded. However, subsurface investigations may reveal additional features. It is possible that intact cultural deposits remain in the periphery of the depression under the lower dune slopes. Subsurface testing is needed to validate the lack of intact cultural deposits in the central part of the site and to determine if intact deposits exist in the less eroded site areas. The further significance of this site is dependent on finding intact subsurface cultural deposits.

Artifact inventory:

Debitage/chunk	1
Other ground stone	5
Fire-cracked rock	4
Burned caliche (uncollected)	11
Other lithic material	1
Total	22

41EP4734 (FB12444)

Elevation: 3,942 feet above mean sea level
Size: 525 square meters
Area excavated: 21 square meters
Features: 1 stain (Feature 1)
Dates: 2 ^{14}C

Site 41EP4734 (Figure A.9) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the southeastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. This site is situated on the south side of a slight rise in a stable vegetated area with only a few large mesquite-anchored coppice dunes. This area is essentially a transition area between the coppice dune field to the south and the more stabilized built-up sands/grassland to the north. Much of

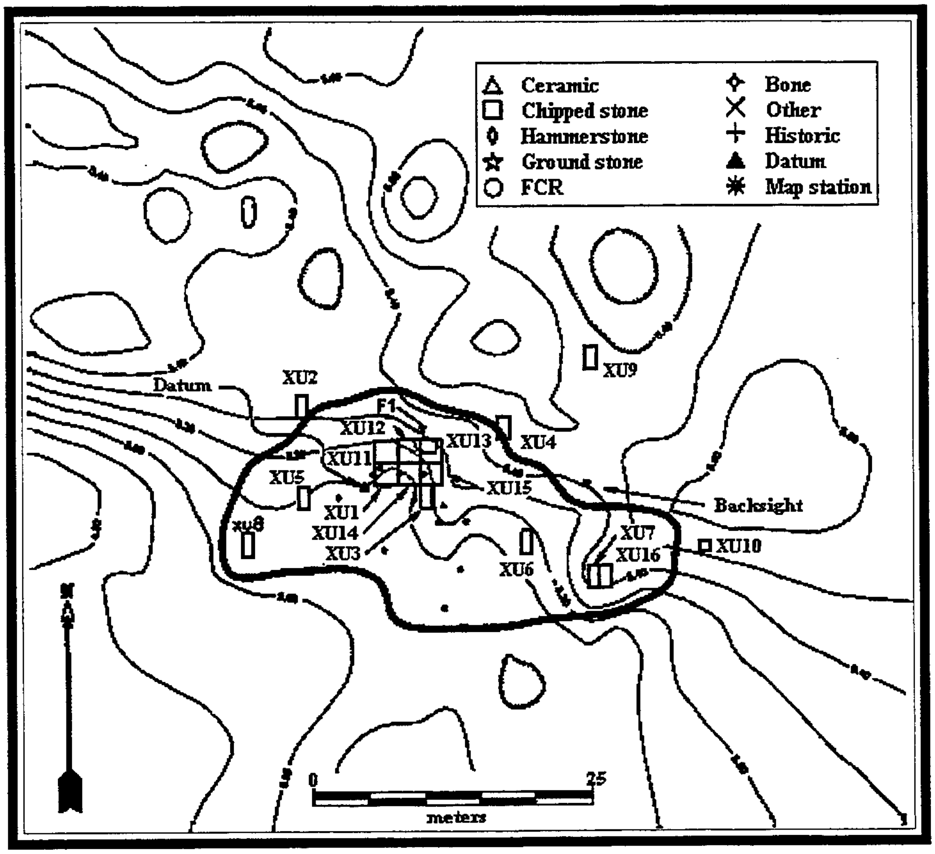

Figure A.9. Site 41EP4734

the site and surrounding area is buried under deposits of eolian sand.

Phase I reconnaissance survey, which employed 15-meter-wide transects, did not locate the site. The surface of the site consisted of a scatter of flaked stone, ceramic sherds, ground stone artifacts, fire-cracked rock, and burned caliche, most of which were located in a depressed area on the southwest side of a low dune. Thirteen artifacts were mapped on the surface of Site 41EP4734. The presence of ceramic artifacts on the site indicates a Formative period occupation, which is supported by radiocarbon dates obtained from charcoal excavated from Feature. Two carbon samples from the feature were submitted for dating, both returning uncorrected dates of 1270 years B.P. with sigmas of 70 and 80 years respectively (Beta 58424 and Beta 58425).

Sixteen test units were excavated on Site 41EP4734. One subsurface feature with an associated activity area was encountered during testing. Additionally, subsurface artifacts were recovered from several test units on the site. In general, it appears that much of the site may remain buried, particularly just to the north and east of the largest excavation block located in the central area of the site. Future archaeological research on the site should include extensive testing of this area.

Feature 1 consisted of an amorphous stain covering an area of about 2 square meters. Dark gray pockets of stain were present within the feature and may represent individual hearths. The stain occurred at a depth of about 30 centimeters below the present site surface and averaged about 20 centimeters thick, but the depth below surface varied because of the slope of the

current ground surface. The visible stain in and around the feature extended to somewhat over 3 meters to the south and west from the northwest corner of the block (Unit 13). It appears that this stain may represent as little as one-half of the actual stain, if the general arc defining its limits in the excavation can be interpolated into a total feature. The dispersed nature of the stain and the lack of precisely identifiable hearth areas within the stain suggests that the original feature(s) was badly deflated or otherwise disturbed prior to its burial. Numerous flaked stone artifacts were found in direct association with the stain and were also recovered from 26 square meters to the south and west of the feature (within the block excavation). This area may represent an activity area associated with Feature 1. Brownware ceramic sherds, bone fragments, fire-cracked rock, and burned caliche were also associated with the feature. Carbon was plentiful within the feature and was collected and dated.

Artifact and sample inventory:

Undifferentiated brownware sherd	53
El Paso Polychrome sherd	1
Unpainted plain sherd	2
Debitage/chunk	67
Tested pebble/cobble	1
Flake	55
Flake, utilized	4
Unimarginal retouch	1
Core fragment	1
Hammerstone, angular fragment	1
Mano	1
Other ground stone	1
Fire-cracked rock	134
Burned caliche	185
Burned caliche (uncollected)	4
Bone, nonhuman	2
Shell	1
^{14}C	30
Flotation	2
Total	546

Site limits have been extended beyond the surface distribution of artifacts based on the recovery of artifacts from test units outside of the surface scatter. Artifacts recovered from test units show a strong tendency to cluster within a 20-centimeter-thick band across the site, suggesting that the site surface was more even at the time of prehistoric occupation than it is today. This concept is supported by quantities of artifacts by depth below surface. Distribution of artifacts in relation to below surface depth shows considerably more variation.

Surface artifact distribution at 41EP4734 hints at, but does not provide, quality evidence for what is below surface. Surface artifacts were clustered in the depression on which the large block excavation was placed. Just two ceramic artifacts were recovered from the surface of the site. These were recovered from the general scatter in and around the depression in the central part of the site.

Lithic materials recovered from the surface do not occur in large numbers, but they do occur in variety. Burned caliche is the most common rock artifact type, but other types include fire-cracked rock, a mano, other ground stone, lithic angular debitage, a hammerstone, and a utilized flake. Surface artifact count for this site is relatively low, but the variation is considerable, providing strong evidence for subsurface artifact deposits, as it is uncommon for small low density sites to contain a high degree of variation in artifact types. Commonly, sites with a wide variety of artifact sites were utilized for several activities and these activities result in the deposition of considerable quantities of artifacts, in addition to a certain degree of variation.

Carbon dates from this site suggest a Mesilla phase occupation. Ceramic sherds recovered from the site are all relatively undiagnostic brownwares, and do not provide particularly corroborating evidence for the particular phase represented. They do support the carbon dates in placing the site within the Formative period, however.

Subsurface testing as well as surface artifact distribution suggest that this site is relatively small and generally contained within the

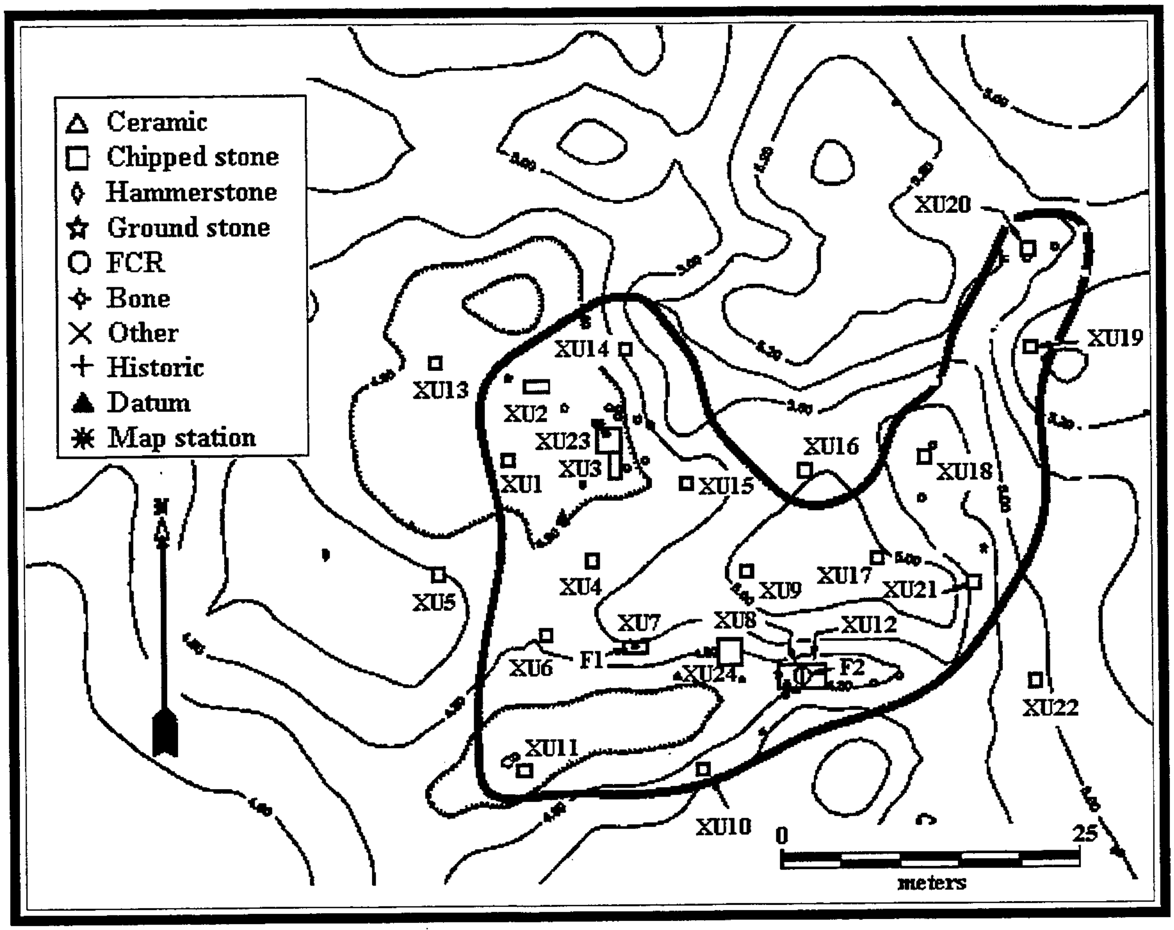

Figure A.10. Site 41EP4735

defined limits. The highest density of materials came from within the main block excavation with densities decreasing away from this central point. There is every indication, however, that a considerable part of this site remains intact, particularly to the north and east of the block excavation.

The extensive level of testing already conducted at this site has resulted in the recovery of what is undoubtedly a good sample of the cultural material present, but the possibility exists for intact features at the site, and an extension of the main block excavation to the north and east will almost certainly result in the recovery of a considerably larger artifact sample and possibly the location of additional features.

41EP4735 (FB12445)

Elevation: 3,945 feet above mean sea level
Size: 1,510 square meters
Area excavated: 39 square meters
Features: 1 stain and 1 caliche borrow pit (Features 1 and 2)
Dates: 1 ^{14}C

Site 41EP4735 (Figure A.10) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. The site is in the southeasternmost part of the Tobin Well project area in Fort Bliss Maneuver Area I. The large mesquite-anchored coppice dunes so common over much of the project area are not present in the immediate vicinity of the site, but begin just to the south.

Phase I reconnaissance survey, which employed 15-meter-wide transects, did not locate the site. During Phase II investigations this site was recorded as being situated on a slight rise in a fairly stable, vegetated area. The site is visible on the surface as a scatter of flaked stone, ceramic sherds, ground stone artifacts, fire-cracked rock, and burned caliche. A total of 41 artifacts was mapped on the surface. The presence of El Paso Polychrome sherds on the site indicates at least an El Paso phase occupation. Much of the site and surrounding area is buried under deposits of eolian sand.

Twenty four test units covering an area of 39 square meters were excavated on Site 41EP4735. Initial testing strategy followed the one 1-by-1 meter square test unit in each 10-meter grid square across the site. Individual test units were expanded to identify any features encountered below the surface. Testing revealed the presence of two subsurface features. However, few subsurface artifacts were recovered from most of the test units. About one-half of the site area appears to be deflated and the remainder of the area appears to be covered with moderate amounts of eolian sand.

Feature 1 consisted of a discrete dark gray stain measuring 50 by 70 centimeters. This stain occurred at a depth of about 40 centimeters below the present site surface and was about 11 centimeters thick. In profile, the stain was basin shaped and contained pockets of darker stains with charcoal flecks. One small flake was the only artifact found in association with Feature 1. This feature may represent the remains of a hearth.

Feature 2 consisted of a circular-shaped caliche borrow pit measuring 1.4 meters in diameter. The first indications of the feature were observed immediately below the blow sand and the feature was excavated at least 40 centimeters into the natural substrate. Several artifacts, including El Paso Polychrome sherds, were recovered from the blow sand. These artifacts were probably from a level approximating the depth of the occupational surface in the area of Feature 2. The bottom of the pit feature was highly irregular and extended 25 centimeters into a hard caliche stratum. This irregularity indicates that chunks of caliche had been removed and no effort had been made to smooth the bottom of the pit. The fill in the pit consisted of brown silty sand with abundant flecks of charcoal. No artifacts or other cultural materials were recovered from within the fill of Feature 2. Back dirt, or spoil, from the borrow pit excavation was visible along the southwest side of the pit during test excavation.

Artifact and sample inventory:

Undifferentiated brownware sherd	15
El Paso Bichrome rim sherd	2
El Paso Polychrome sherd	8
Unpainted plain sherd	1
Debitage/chunk	5
Flake	4
Other ground stone	7
Fire-cracked rock	59
Fire-cracked rock (uncollected)	1
Burned caliche (uncollected)	24
^{14}C	13
Soil	5
Flotation	4
Lithic material type	4
Total	152

The surface artifact distribution covered a considerably larger area than the test excavations indicated for the site limits, particularly to the northeast. No artifacts were recovered from any of the test units east of Unit 12. It is possible the surface artifacts in this part of the site are eroded from a site just to the north of the northeast arm of Site 41EP4735. The artifacts in this area are all aligned with a very shallow, southerly trending drainage, and may well indicate the presence of a buried site near the head of the shallow drainage rather than the extension of Site 41EP4735 to the north and east of where test units yielded subsurface cultural material.

The absolute elevation of artifacts shows a bimodal curve with all of the artifacts occurring

in the 5.20–5.30-meter elevation range coming from Units 8 and 12, which encompassed Feature 2. All the ceramics recovered from the site also originated from this immediate area. Feature 2 has been dated with associated carbon to an uncorrected age of 520 ± 90 B.P. This corresponds well with the El Paso Polychrome sherds that were recovered. Suspiciously, almost all artifacts recovered from other excavation units were from the 5.40–5.50-meter elevation range, and no ceramic sherds were present in this subset of the site artifact collection.

Surface distribution of stone artifacts offers some evidence relative to the multiple component theory. These materials are relatively limited in artifact type with no particular differentiation in types across the site. The artifacts tend to cluster primarily in the vicinity of Unit 23, but also occur in deflated or otherwise eroded places across the site. This cluster of primarily burned caliche near Unit 23 probably relates to the single artifact recovered from Level 1 in this unit and apparently was not deposited during the same period of occupation as the 29 artifacts recovered from Level 4 of this 2-square-meter unit.

It is quite possible the site contains multiple components with an El Paso phase component associated with the caliche borrow pit (Feature 2) and an earlier component represented by artifacts recovered from the 5.40–5.50-meter elevation. Planned extended-count dating of carbon recovered from Feature 1 may provide substantiating evidence for this. Additional evidence that suggests multiple component occupancy at the site is a similar bimodal distribution of artifacts with depth in Unit 23, northwest quadrant, where one artifact was recovered from Level 1 and ten artifacts from Level 4, but none in between.

The total number of artifacts recovered from Site 41EP4735 is not large, but their spatial distribution and artifact type variety is interesting. The site apparently contains multiple components, with an El Paso phase occupation and an earlier occupation. Surface artifacts, at least on the west one-half of the site, can apparently be assigned to the El Paso phase occupation, while artifacts recovered from the 5.40–5.50-meter elevation range (generally excavation Level 3 or 4) in test units should be viewed as having originated from an earlier period of site use.

A breakdown of artifacts by general types and quantity for the collection when viewed in terms of the two component collections is discussed previously. There is certainly more variety in the El Paso phase collection, but this is not surprising given the number of artifacts recovered from the surface. The greatest difference is probably in the lack of ceramic sherds from the proposed earlier component. Distribution of artifacts by proposed component according to general type and quantity is as follows:

Artifact Type	EP Phase	Early
Undifferentiated brownware	17	–
El Paso Bichrome rim	1	–
El Paso Polychrome	7	–
Debitage/chunk	3	–
Utilized debitage/chunk	1	–
Flake	4	2
Other ground stone	4	–
Fire-cracked rock	10	3
Burned caliche	24	50

Testing at Site 41EP4735 indicates that this site is a multiple component site with vertically stratified cultural deposits. The later component, which is represented by surface artifacts and those recovered from absolute elevations in the 5.20–5.30-meter range, is apparently an El Paso phase occupation. This period of use is identified by both the presence of El Paso Polychrome sherds and from a ^{14}C date obtained from Feature 2, which is believed to be associated with this occupation. The second component is earlier and artifacts from this component were recovered from test units. These materials occur in the 5.40-meter elevation range and are apparently associated with Feature 1. Carbon from Feature 1 is being dated using

the extended count process, and a date to corroborate or compromise this hypothesized multiple componency should be forthcoming. The origin of artifacts is unknown from the east end of the site where test units failed to yield even a single subsurface artifact. It is possible these materials have been washed southward into this site along the small drainage in which they occur.

Site 41EP4735 is of value because it can address several important research or context-related questions that have been identified for the region. The presence of carbon yielding features means that it can be absolutely dated, as well as relatively dated by the prehistoric ceramics that were recovered. Features and associated artifact types provide evidence for site function and length of use. Both components appear to represent short-term occupations in the transitional zone between the Franklin Mountain alluvial fan and the Hueco Bolson desert floor. The components can provide comparative and contrastive information about land use through time.

Additional excavations are recommended for Site 41EP4735, particularly in the west half of the site. These excavations should be designed to further address the question of multiple componency and to collect additional artifacts that will be of value in addressing both component and site function.

Recommended future archaeological research should include extensive additional testing in higher areas around the perimeter of the site.

41EP4736 (FB12446)

Elevation: 3,948 feet above mean sea level
Size: 1,200 square meters
Area excavated: 32 square meters
Features: none

Site 41EP4736 (Figure A.11) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. This site is situated partially on an area of high eolian deposition and partially in a depression north of the rise. It is in a fairly stable, vegetated area with no large mesquite-anchored coppice dunes in the immediate vicinity of the site.

Phase I reconnaissance survey using 15-meter-wide interval transect spacings did not locate the site. Surface evidence consisted of a scatter of mainly ceramic artifacts with a few flaked stone artifacts, fire-cracked rock, and burned caliche. A total of 31 artifacts was mapped on the surface. The presence of El Paso Polychrome sherds on the site indicates an El Paso phase occupation. Much of the southern part of the site appears to be buried under deposits of eolian sand, whereas the northern part appears to be deflated.

Thirty-one test units covering 32 square meters excavated on Site 41EP4736 encountered no subsurface features. Twenty-three artifacts were recovered from test units across the site. Artifacts from units in the low lying portions of the site occurred in the blow sand, whereas artifacts from units in the less eroded site areas tended to occur at a similar absolute elevation, but in good context below the blow sand. For example, artifacts from Units 1, 3, 4, 8, and 28 were recovered from an average level of 3.5, and artifacts from Units 10, 11, 13, 14, 20, 21, 25, and 26 had an average excavation level of recovery of 1.3. The remaining two test units (Units 7 and 16) that produced artifacts were on the slope between the two elevation extremes and had an average level for artifact recovery of 2.25. A majority of the recovered artifacts are ceramic sherds. In general, it appears that the northern part of the site is deflated and the southern part is fairly stable.

Artifact and sample inventory:

Undifferentiated brownware sherd	37
El Paso Bichrome sherd	5
El Paso Polychrome sherd	4
Unpainted plain sherd	1
Debitage/chunk	1

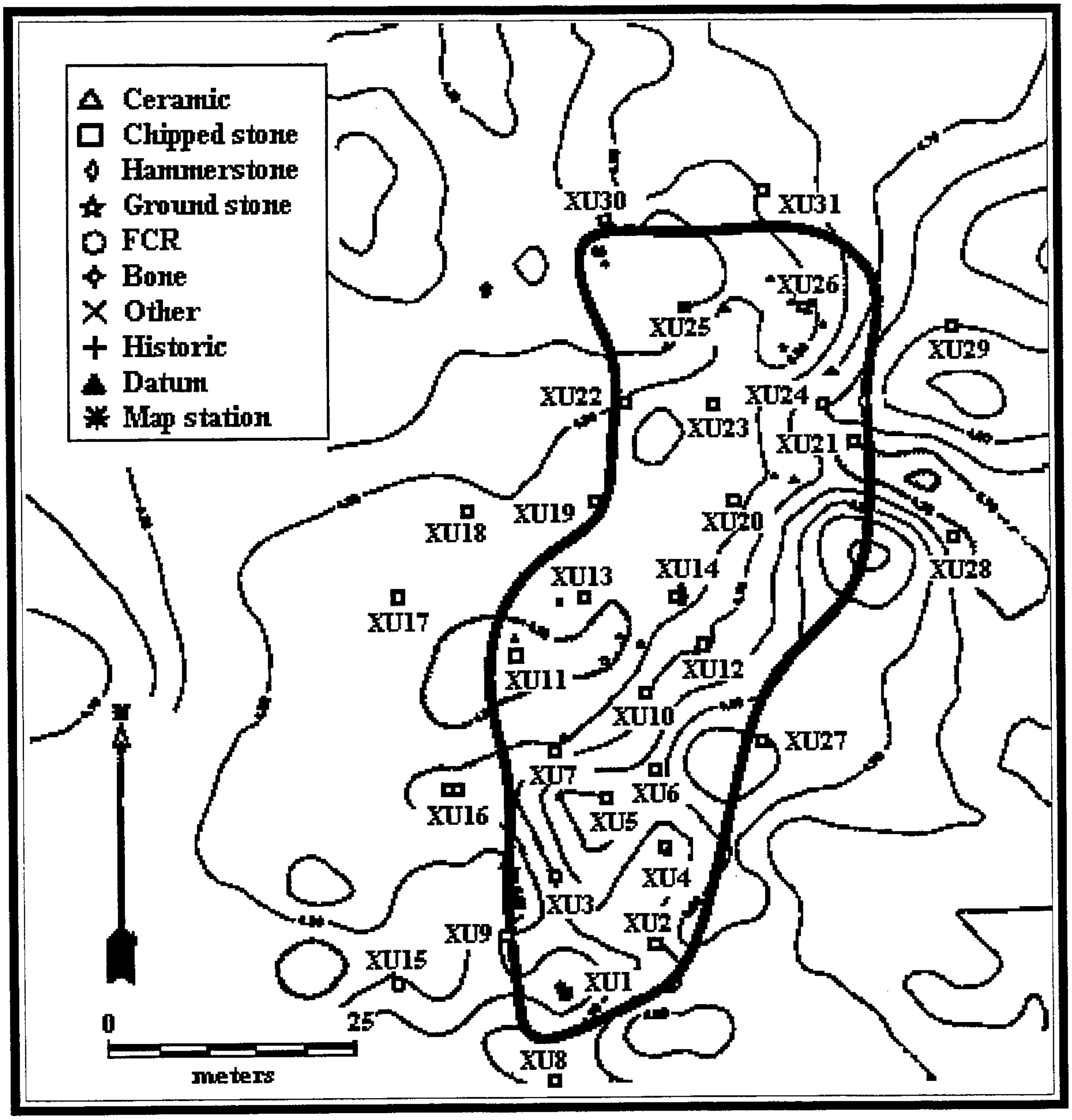

Figure A.11. Site 41EP4736

Flake	4
Other ground stone	1
Flotation	1
Total	54

Surface artifact distribution across the site is of little use in determining activity areas, as the scatter is very light and testing evidence documented the fact that these materials occur on the surface only in deflated areas. The deflation factor biases any attempt at spatial studies based on surface data. Artifact types and dispersion across the site remain very similar, however, even when subsurface data is included. Ceramic artifacts were present over most of the surface of the site in deflated areas. Stone artifacts recovered from the surface are too few in number to provide much information con-

cerning site use. Only two of these artifacts were recovered from the surface, both from the deflated part of the site.

This site varies from almost all other sites in the project area in having no recorded burned rock (neither burned caliche nor fire-cracked rock). There is little evidence to suggest that hearths or other heat-related features exist at the site. The site apparently represents a short-term occupation and the limited variety of artifact types in the collection suggests that the number of different activities conducted at the site was limited.

The site yielded relatively datable artifacts in the form of El Paso Polychrome ceramic sherds and retained intact subsurface cultural deposits in its undeflated southern and eastern areas. Because of these factors the site is worthy of additional attention in the form of mitigation excavations. Additional work at the site can be expected to yield information concerning site function, which would provide additional information about subsistence and settlement patterns used across the region and changes in these patterns as related to specific site uses through time. Unit 16 contained a small dispersed carbon stain that may be the remnant of a heat-related feature. If such features did exist on the site, then additional excavations can be expected to recover carbon for absolute dating. This site may be important in providing regional information concerning land use and site types precisely because of the currently perceived lack of variety in the artifact assemblage. This sets the site apart from the majority of the small sites in the area and may indicate a different site type and function. Mitigation plans for the project area should include this site.

41EP4737 (FB12447)

Elevation: 3,948 feet above mean sea level
Size: 2,340 square meters
Area excavated: 3 square meters
Features: none

Site 41EP4737 (Figure A.12) is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the northeastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. This site is in and along a linear depression surrounded by elevated areas of eolian deposits in a fairly stable, vegetated area with no large mesquite-anchored coppice dunes in the immediate vicinity. In general, it appears that the central part of the site is deflated and soils are shallow but still exist. Areas around the perimeter of the site are covered with fairly deep eolian sand.

Site 41EP4737 was not located during the Phase I reconnaissance where 15-meter-wide survey transects were employed. The surface of the site consisted of a scatter of ceramic sherds, flaked stone, ground stone artifacts, fire-cracked rock, and burned caliche, with most of these artifacts in the main depression. A total of 45 artifacts was mapped on the surface of Site 41EP4737. The presence of El Paso Polychrome and Playas Red ceramic sherds indicates an El Paso phase occupation. Much of the site may be buried under deposits of eolian sand, but the limited testing conducted during Phase II investigations provides little evidence for substantial subsurface cultural deposits.

Three test units were excavated on Site 41EP4737. Because the site was found during the investigations at Site 41EP4722 late in the project, no time was available for intensive formal testing. As a result the site was minimally tested with the three 1-by-1-meter hand excavation units. No subsurface features were found and only one subsurface artifact was recovered (from Unit 3).

Artifact and sample inventory:

Undifferentiated brownware sherd	17
El Paso Bichrome sherd	5
El Paso Polychrome sherd	4
Playas Red sherd	1
Flake	6
Core	2
Metate fragment	1

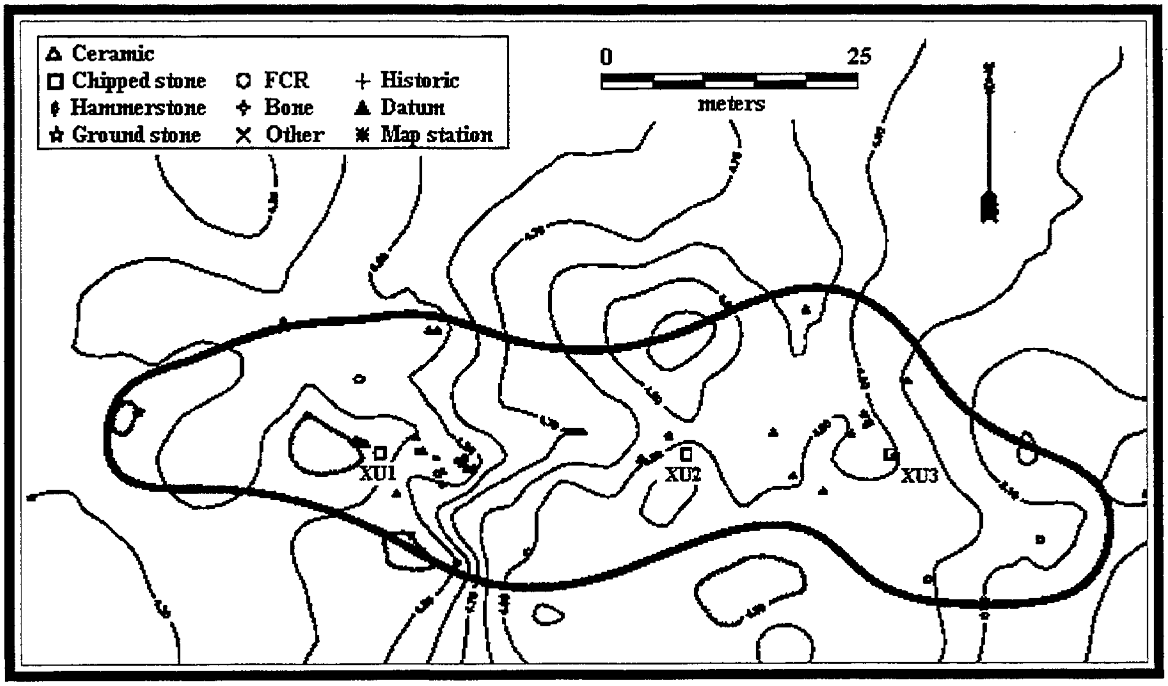

Figure A.12. Site 41EP4737

Mano/metate	1
Other ground stone	2
Fire-cracked rock	4
Burned caliche (uncollected)	2
Total	45

Flaked stone artifacts are represented in the site artifact collection by six flakes and two cores. The presence of these artifacts indicate some core reduction and/or flaked stone tool production occurred during site occupation, but, given the low quantity and variety of recovered flaked stone artifacts in the collection, it is not reliably possible to use these materials in further explanation of site type or function. The majority of the flaked stone is concentrated in the most deflated area of the site, but additional testing is needed to verify this distribution.

Ceramic sherds are the most common artifact type at the site. They generally occur within two clusters, one near Unit 1 with the flaked stone and one near Unit 3. The types suggest an El Paso phase occupation. Additional testing is needed to further define artifact clusters and site limits and to further identify needs, if any, for mitigation efforts. Initial testing shows little evidence for significant intact cultural deposits, but this testing was not intensive. Four to five additional units scattered across the site will provide sufficient evidence to determine the significance of this site. Recommended future testing should be in the areas around the site boundaries and in the vicinity of Unit 3, which produced one subsurface artifact and charcoal flecks.

41EP4738 (FB12448)

Elevation: 3,940 feet above mean sea level
Size: 2,230 square meters
Features: none

Site 41EP4738 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the east-central part of the Tobin Well project area in Fort Bliss Maneuver Area I. Phase II investigators recorded the site. The site, which is in the grasslands of the project area, is configured by a concentration of artifacts in a deflated area that slopes to the north and a few artifacts sparsely scattered

around the main concentration. The light scatter extends nearly to the west edge of Site 41EP4721 on the east.

A total of 184 artifacts was mapped on the surface. The artifacts consist of flaked stone, ceramic sherds, ground stone, fire-cracked rock, and burned caliche. Most artifacts appear to have eroded out of large dune field on the south edge of the site indicating that some cultural materials are likely to remain buried under eolian deposits in this area. The ceramic artifacts on the site indicate a Formative period use of the site.

Ceramic sherds recovered from the site were found in the midst of the heavy concentration. It is likely they are part of the assemblage of materials associated with the main site occupation. The flaked and ground stone artifacts are also thoroughly mixed within the main artifact concentration. Much of the ground stone (17 of 23) on the site has also been used in some other manner and it is likely that its last function was not as ground stone, but as hearth rock or, in one instance, a core. This indicates that the relative quantities of artifacts recorded as ground stone probably misrepresents the actual amount of grinding that occurred at the site, or it simply may indicate re-use of the ground stone by subsequent inhabitants of the site.

The high density of artifacts of multiple types in the same concentration may indicate that the materials are in a trash midden rather than being *de facto* deposits resulting from deposition in place following use, or simply that multiple tasks were performed at this locale.

Artifact inventory:

Undifferentiated brownware sherd	5
El Paso Bichrome sherd	1
Debitage/chunk	6
Debitage/chunk, utilized	1
Tested pebble/cobble	2
Flake	11
Flake, utilized	2
Hammerstone, rounded	1
Metate fragment	3
Other ground stone	20
Fire-cracked rock	35
Burned caliche	1
Burned caliche (uncollected)	96
Total	184

This site appears to be a good candidate for addressing multiple area and regional research questions concerning settlement and subsistence systems. Dating of the site is possible in relative terms from temporally diagnostic artifacts, and probably in absolute terms from carbon associated with expected cultural features at the site. Artifact density is high enough to indicate some duration in time of site use and suggests that structures and/or other cultural features are likely. This same artifact density is a strong indicator that intrasite activity areas will be identifiable and that site function can be addressed. Subsurface cultural materials can be expected to occur to significant depths in this part of the project area.

Subsurface testing is needed to determine site limits and quantity and quality of intact subsurface cultural materials. Such testing will provide additional information concerning the research questions mentioned above, and provide needed information for determining the proper scope of mitigation efforts that will be required at the site.

41EP4739 (FB12449)

Elevation: 3,945 feet above mean sea level
Size: 6,000 square meters
Features: none

Site 41EP4739 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I.

Phase I survey recorded a single isolated observation. More intense 1-meter reconnaissance survey transects of Phase II investigations found additional artifacts resulting in site status designation. The site consists of a low to mod-

erate density surface scatter of artifacts. A slight concentration of artifacts was present near the center of the site. Most of the artifacts were in deflated areas around the perimeter of dunal soils and dunal deposits of eolian sand. Cultural materials are expected to remain buried under eolian sands on the site. A total of 54 artifacts was mapped on the surface of Site 41EP4739. The artifacts consist of flaked stone, ceramic sherds, ground stone, fire-cracked rock, and burned caliche. The presence of brownware sherds on the site indicates at least a Formative period occupation.

The rather sparse scatter of artifacts visible across the surface of this site is probably more a factor of thick overburden and differential deflation and erosion than a true indicator of location and density of subsurface cultural deposits. Extensive testing on other sites in the vicinity has shown that to be the case in the built-up sands of the eastern half of the project area.

The main artifact variety is generally within the main cluster of materials in the central area of the site. Fire-cracked rock and burned caliche are the dominant materials on both the north and south ends of the site. Artifact variety at the site suggests a number of different activities were undertaken during the period of site occupancy, but surface artifact density provides little supportive data for this. However, the surface artifact density in this part of the project area may have little relevance to the quantity of subsurface materials.

Artifact inventory:

Undifferentiated brownware sherd	4
Debitage/chunk	1
Tested pebble/cobble	1
Flake	3
Core	1
Metate fragment	1
Other ground stone	4
Fire-cracked rock	11
Burned caliche (uncollected)	28
Total	54

Subsurface testing across a wide part of this site is needed to determine limits of subsurface cultural materials and to determine the amount and quality of these materials. The variety of artifacts on the surface suggests that the site may have been more than a short-term camp and that features can be expected in subsurface contexts. The site can be expected to yield information concerning site function, intrasite activities, and variety within the settlement and subsistence systems during the Formative period in the Hueco Bolson.

41EP4740 (FB12450)

Elevation: 3,940 feet above mean sea level
Size: 620 square meters
Features: none

Site 41EP4740 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is in an area of fairly stable soils vegetated with grasses and yucca.

Phase I reconnaissance survey did not identify the site in its 15-meter-wide transects. Phase II recorded the site as a low to moderate density scatter of artifacts on either side of a deeply cut dirt road. A slight concentration of artifacts was present on the north slope of the road and a few artifacts were dispersed along the road. A total of 33 artifacts was mapped on the surface of this site. The artifacts consist of flaked stone and ground stone items, fire-cracked rock, and burned caliche. No temporally diagnostic artifacts were present on the site and no period of occupation can be determined at this time. Intact subsurface cultural materials can be expected to remain buried under eolian sands, particularly on the northern part of the site.

Artifacts present on the extreme west of the site are thought to have been displaced by road grading, but this is not as clear for those materials at the eastern end of the site. The eastern

materials extend to near the scatter of material making up Site 41EP4732 to the south. Cultural materials found in the road and south of it on the eastern end of the site lie within the same geomorphic feature as most of the material on the surface of Site 41EP4732. It is possible the artifacts from the eastern end of 41EP4740 are actually an extension of the scatter from 41EP4732; however, additional testing is needed to substantiate this premise.

The central area of the site contains not only the most dense concentration of cultural material but also the greatest variety. There is enough burned rock to indicate the presence of at least one feature at the site, and it is possible that road grading has removed the feature(s) associated with the artifact concentration.

Artifact inventory:

Debitage/chunk	1
Flake	3
Flake, utilized	2
Hammerstone, rounded	1
Other ground stone	7
Fire-cracked rock	9
Burned caliche (uncollected)	10
Total	33

Subsurface testing is needed at this site to determine the horizontal extent of subsurface cultural material as well as the quantity and quality of such material. The current lack of temporally diagnostic artifacts at the site suggests some limitations to the quality of information the site can provide, but the presence of a considerable quantity of burned rock indicates that the site contained at least one feature from which datable carbon is a possibility. Further testing investigations will serve to document the potential of this site for dating and for addressing other regional research questions.

41EP4741 (FB12451)

Elevation: 3,940 feet above mean sea level
Size: 1,575 square meters
Features: none

Site 41EP4741 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is 200 meters northeast of the existing Hawk Missile facility.

Phase I reconnaissance survey recorded this site as a single isolated observation. During Phase II, through more intensified surveying, site status was determined when investigations resulted in finding additional artifacts. This site consists of two loosely clustered concentrations of artifacts on a north facing slope. This slope continues to the northwest to a playa located between 41EP4713, 41EP4715, 41EP4718, and 41EP4741. It is in an area of fairly stable soils vegetated with grasses and yucca and the site appears to be covered with deep eolian sands. Most of the artifacts were in slight depressions indicating that portions of the site may remain buried under the eolian deposits.

A total of 30 artifacts was mapped on the surface of 41EP4741. The artifacts consist of ceramic sherds, flaked stone and ground stone items, fire-cracked rock, and burned caliche. One projectile point was also present. A brownware sherd recovered from the north cluster of artifacts indicates at least a Formative period use of the site. The same cluster yielded the projectile point. The point, however, is of a style that may be associated with either the Archaic period or the Formative period. This suggests the possibility of multiple periods of site use or "pickups" from earlier site occupations. This is also suggested by the relatively distinct clustering of materials included within the site with approximately 30 meters separating them.

A cursory examination of artifact distribution across the site shows some variation, but the lack of understanding of subsurface artifact variety and quantity severely limits interpretation of this distribution. The single ceramic recovered from the site was from the northern cluster as was the only recovered projectile point. Two hammerstones, fire-cracked rock, burned

caliche, and a piece of ground stone were also present in the northern cluster. This cluster contains a surprising variety of artifacts, given the small quantity present, and multiple types of activities are indicated. The southern artifact cluster is larger and contains less artifact variety, which can be interpreted as resulting from a narrower scope of activities than occurred in the northern cluster area.

Artifact inventory:

Undifferentiated brownware sherd	1
Tested pebble/cobble	2
Flake	3
Projectile point	1
Hammerstone, angular	1
Hammerstone, rounded	1
Hammerstone, rounded	1
Other ground stone	3
Fire-cracked rock	4
Burned caliche (uncollected)	13
Total	30

Although only 30 artifacts were found and mapped on the surface of the site, these artifacts cover all the major categories under the present level of analysis. The variety indicates that multiple activities occurred on the site. Additional studies are needed to make more specific statements concerning site activities and site function possible. It is probable, given the artifact variety and relative low density, that additional subsurface cultural materials exist at the site. It is also probable that along with these artifacts are cultural features. Burned rock on the site surface indicates that heat-related features were present at the site and are likely to remain below the present surface. These features may provide datable carbon for absolute dating of site components.

Subsurface testing is required at this site to determine the quantity and quality of subsurface cultural material and for determining site limits. This information is needed to further address the site's role as a source of information in addressing area research questions. This testing is also needed as a means for further defining the role of this site in prehistory and its role in the historical context.

41EP4742 (FB12452)

Elevation: 3,947 feet above mean sea level
Size: 220 square meters
Features: none

Site 41EP4742 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the eastern part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is in an area of fairly stable soils vegetated with grasses and yucca, and the area appears to be covered with a layer of eolian deposition.

Phase I reconnaissance investigations did not locate this site. However, the implementation of a more intensified survey strategy during Phase II, led investigators to locate and record it. It consists of a small scatter of artifacts in a deflated area between larger sites 41EP4722 and 41EP4739. Some cultural material may remain buried under deposits of sand.

A total of 25 artifacts mapped on the surface of Site 41EP4742 consisted of flaked stone, ceramic sherds, fire-cracked rock, and burned caliche. The presence of brownware sherds on the site indicates a Formative period occupation. The small quantity of materials on the surface and the small site area make any determination of site activities impossible.

This site appears relatively insignificant in terms of site size and density of artifacts, but it is entirely possible that there is considerably more to the site than meets the eye. The presence of the artifacts in a deflation suggests that the only reason they are visible on the surface at all is because of erosion in this locale. This site may be a continuation of either of the flanking sites, but appears somewhat isolated because of the less eroded areas between, which serve to cover up artifacts. It is also possible the site is simply the remains of a small, short-term camp, but subsurface testing is needed to determine the

true character of this small artifact scatter. Test units should be placed within and around the artifact scatter to determine the degree of erosion of sediments bearing cultural material and to test for intact subsurface cultural materials beyond the surface visible scatter. Until additional work is completed to determine the real character of the site, it is difficult to determine where it fits into cultural context oriented designs. It is also difficult to address all the specific research questions for which the site may provide data.

Artifact inventory:

Undifferentiated brownware sherd	2
Flake	2
Fire-cracked rock	1
Burned caliche	7
Burned caliche (uncollected)	13
Total	25

41EP4743 (FB12453)

Elevation: 3,936 feet above mean sea level
Size: 515 square meters
Features: none

Site 41EP4743 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the east-central part of the Tobin Well project area in Fort Bliss Maneuver Area I.

Phase I reconnaissance survey did not discover the site. However, Phase II investigators employing a more intensified survey strategy found and recorded it. The site is in the transition zone between the dune field and the more stable grassland, which is vegetated with grasses and yucca; some areas appear to be covered with deposits of eolian sand. One large mesquite-anchored coppice dune is present near the north edge of the site and several dunes are located to the south.

The site is a scatter of artifacts in an interdunal area. Most of the artifacts are in the most highly deflated areas and tend to be clustered on either end of the site (east and west) where deflation in greatest. Some cultural material may remain buried under the eolian deposits.

A total of 22 artifacts was mapped on the surface of 41EP4743. The artifacts consist of flaked stone, ceramic sherds, ground stone items, fire-cracked rock, and burned caliche. The presence of a brownware sherd on the site indicates a possible Formative period use of the site.

The site appears to retain eolian sand in sufficient depth to contain intact subsurface cultural materials. Subsurface testing is needed to determine if this is the case and to determine the lateral extent of the site. A sufficient amount of burned rock on the site surface indicates the former existence of heat-related features and it is possible that the site can be more accurately dated with carbon from these features.

Artifact inventory:

Undifferentiated brownware sherd	1
Debitage/chunk	1
Tested pebble/cobble	1
Hammerstone, rounded	1
Other ground stone	1
Fire-cracked rock	4
Burned caliche (uncollected)	13
Total	22

41EP4744 (FB13418)

Elevation: 3,936 feet above mean sea level
Size: 1,420 square meters
Features: none

Site 41EP4744 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the north-central part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is in an area of fairly stable soils vegetated with grasses and yucca, and the central part of the site appears to be covered with deep deposits of eolian sand. A few large mesquite-anchored coppice dunes are around the perimeter.

Phase I reconnaissance survey recorded the site as a single isolated observation. Through more intensified efforts during the Phase II investigations, the site was determined to consist of two concentrations of artifacts in two separate deflations. It is probable that some intact cultural deposits remain buried at the site.

A total of 32 artifacts was mapped on the surface of the site. The artifacts consist of flaked stone, ceramic sherds, ground stone items, fire-cracked rock, and burned caliche. The brownware sherd recovered from the site infers Formative period use of the site.

This site may contain the remains of more than a single occupation and, in fact, two distinct artifact concentrations indicate this. However, the thicker sands in the underlying area may conceal additional cultural material that would serve to better connect the concentrations. There is no distinct difference between the artifact types in the two concentrations. The single sherd recovered from the site was from the north concentration, but the variety of stone artifacts (including burned rock) is similar in both concentrations. Both contain burned rock indicating the presence of heat-related features, flaked stone flaking debris and cores indicating core reduction and/or flaked stone tool production, and pieces of unidentified ground stone.

Artifact inventory:

Undifferentiated brownware sherd	1
Debitage/chunk	3
Utilized Chunk	2
Tested pebble/cobble	2
Flake	1
Core	1
Hammerstone, angular	1
Other ground stone	4
Fire-cracked rock	6
Burned caliche (uncollected)	11
Total	32

Subsurface testing is needed at this site to determine the likelihood of these two concentrations being the result of multiple periods of site use, to determine the site limits, and to determine the quantity and quality of possible intact subsurface deposits of cultural material. Burned rock is present in sufficient numbers in each of the concentrations to indicate that a heat-related feature was probably present in each location. If this is the case it may be possible to recover carbon for dating the individual concentrations. The site has already produced one sherd that provides some temporal information concerning the time of site use. Additional, more specific datable items and materials are likely. The ability to place the site in a relative time of occupation makes it of value in comparative studies of subsistence and settlement systems, site function, and intrasite activity partitioning.

41EP4745 (FB13419)

Elevation: 3,935 feet above mean sea level
Size: 430 square meters
Features: none

Site 41EP4745 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the north-central part of the Tobin Well project area in Fort Bliss Maneuver Area I in an area of large mesquite-anchored coppice dunes and deep blowouts. Thin deposits of eolian deposition may cover some cultural materials in the central area of this site and it is possible that materials extend into the deeper sands nearer the dunes.

Phase II survey recorded the site, which consists of a low density artifact scatter dispersed throughout a single deflation. Eight artifacts mapped on the surface include one hammerstone, fire-cracked rock, and burned caliche. No temporally diagnostic artifacts were present on this site and no period of occupation can be determined at this time.

If this site is datable, it can provide information of value to subsistence and settlement questions important to understanding the prehistoric use of the region. The presence of burned rock at the site suggests the former existence of some kind of heat-related feature.

Subsurface testing is needed to establish the presence or absence of extant features retaining carbon for dating and to also establish site limits and presence of other intact subsurface cultural deposits. Results of subsurface testing will be the determining factor in addressing further needs for mitigation.

Artifact inventory:

Hammerstone, rounded	1
Fire-cracked rock	6
Burned caliche (uncollected)	1
Total	8

41EP4746 (FB13420)

Elevation: 3,934 feet above mean sea level
Size: 630 square meters
Features: none

Site 41EP4746 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the north-central part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is in an area of large mesquite-anchored coppice dunes and deep blowouts. Thin deposits of eolian sand over the central area of the site may cover some cultural materials and it is possible that additional materials are concealed beneath the deeper sand nearer the dunes.

Phase I reconnaissance investigations identified and recorded the site, which consists of a low density artifact scatter dispersed throughout a single deflation. A total of six artifacts was mapped on the surface. The artifacts consist of ground stone and flaked stone items and fire-cracked rock. Artifact variety at the site is considerable given the small number present. No temporally diagnostic artifacts were present on this site and no period of occupation can be determined at the present time.

If this site is as it appears from the surface scatter of materials, its importance lies in whether it can be dated. If so, then it will provide useful data concerning subsistence and settlement issues in use during that period in prehistory. It is possible the site is more substantial than it appears from the surface, but this is not expected. Subsurface testing is necessary to establish the presence or absence of intact cultural deposits. If intact materials remain, dating becomes of primary importance.

Artifact inventory:

Flake	1
Flake, utilized	1
Tested Pebble	1
Other ground stone	2
Fire-cracked rock	1
Total	6

41EP4747 (FB13421)

Elevation: 3,930 feet above mean sea level
Size: 210 square meters
Features: none

Site 41EP4747 is in the Chihuahuan Desert along the west margin of the Hueco Bolson in El Paso County, Texas. It is in the south-central part of the Tobin Well project area in Fort Bliss Maneuver Area I. The site is in an area of large mesquite-anchored coppice dunes and deep blowouts and the deflation containing the artifacts is surrounded by dunes. An old graded area and a two-track military trail run north-south immediately east of the site. Thin deposits of eolian sand may cover some cultural materials in the central part of the site, but the fringe areas of the deflation are the most likely geomorphic contexts for containing intact subsurface cultural materials.

Site 41EP4747 was found and recorded during the Phase I reconnaissance investigations in the project area. This site consisted mainly of a scatter of fire-cracked rock and fire-cracked ground stone fragments in a single deflation. One piece of flaked stone debitage and one piece of burned caliche are also present. A total of four artifacts was mapped on the surface of the site. No temporally diagnostic artifacts were present on this site and no period of occupation can be determined at this time.

Several pieces of fire-cracked ground stone clustered in the southwest area of the site may be the remnants of a heat-related feature. It is possible that some of this feature remains below surface, but it appears unlikely, as there was no evidence of stains in the vicinity of the artifacts.

Subsurface testing is needed at this site to establish the presence or absence of remaining intact cultural deposits, and to locate the lateral limits of any such deposits. The future value of this site probably lies in its ability to be dated. If testing fails to reveal anything suggesting that the site is datable, then its value as a useful source of prehistoric information has probably been exhausted through the surface collection and mapping.

Artifact inventory:

Fire-cracked rock	3
Burned caliche (uncollected)	1
Total	4

Appendix B
Instrumental Neutron Activation Analysis (INAA) Data

File name C:\IGPET\TW\ROC

Sample	TW-1	TW-2	TW-3	TW-4	TW-5	TW-6	TW-7	TW-8
Na2O	1.89	1.73	1.08	1.25	1.30	0.30	1.26	1.29
Sc	6.06	4.25	5.59	2.75	3.28	7.72	9.90	5.03
Cr	16	20	27	14	16	9	35	22
FeO	3.74	2.30	2.54	1.53	1.72	1.57	3.82	2.18
Co	4.5	4.4	6.6	3.1	3.7	4.2	11.8	6.1
Zn	100	49	43	27	31	12	81	43
As	6.2	5.8	7.1	3.8	3.7	10.0	3.7	5.3
Br	5.9	4.1	10.9	2.7	2.0	11.4	1.5	0.7
Rb	196	122	85	71	67	196	113	84
Sb	0.3	0.6	0.5	0.4	0.4	0.6	0.6	0.7
Cs	4.9	2.9	3.6	1.9	2.1	11.1	10.6	3.4
Ba	366	5	5	514	532	72	435	536
La	116.0	38.5	27.0	19.8	21.7	11.2	35.1	24.8
Ce	213.0	80.9	51.7	33.9	39.8	35.2	67.8	44.7
Nd	109.0	32.1	18.9	14.2	0.0	0.0	33.6	21.3
Sm	22.06	7.32	4.79	2.80	3.42	3.62	6.27	3.96
Eu	1.55	0.91	0.86	0.60	0.62	0.46	1.14	0.80
Tb	3.20	1.07	0.66	0.40	0.44	0.79	0.86	0.56
Yb	11.31	5.48	2.68	2.12	1.77	3.45	2.43	1.73
Lu	1.591	0.771	0.419	0.306	0.271	0.471	0.344	0.267
Hf	13.37	15.30	7.52	6.73	6.16	8.28	5.19	5.44
Ta	2.54	1.70	0.95	0.60	0.58	2.02	0.83	0.60
Th	31.40	10.58	8.40	5.50	6.23	21.29	10.52	6.04
U	4.6	2.9	1.8	1.4	1.3	7.5	2.0	1.5

File name C:\IGPET\TW\ROC

Sample	TW-9	TW-10	TW-11	TW-12	TW-13	TW-14	TW-15	TW-16
Na2O	0.04	1.00	1.02	1.82	1.10	1.28	1.34	2.41
Sc	2.13	2.33	4.86	10.17	3.67	3.94	3.53	4.61
Cr	12	14	14	22	19	25	18	18
FeO	0.82	1.25	2.00	5.97	1.83	1.97	1.73	3.49
Co	1.5	3.1	2.4	9.2	4.3	4.6	4.0	4.3
Zn	24	53	60	134	31	41	38	78
As	14.9	2.2	5.5	6.8	5.4	3.7	2.9	7.1
Br	0.4	18.0	2.5	8.8	6.4	5.0	7.4	6.2
Rb	89	51	191	2	64	68	68	89
Sb	0.6	0.4	0.5	0.5	0.4	0.5	0.4	0.5
Cs	1.5	1.5	3.9	6.1	2.6	3.0	2.5	2.8
Ba	225	518	839	394	528	524	539	704
La	8.7	15.8	33.3	98.8	18.8	19.7	19.1	51.6
Ce	21.2	26.4	70.4	215.4	33.2	37.0	35.3	93.0
Nd	8.3	11.7	25.1	113.0	15.6	17.4	16.2	37.5
Sm	1.84	2.30	5.28	25.39	3.14	3.14	2.83	6.50
Eu	0.30	0.51	0.35	2.01	0.68	0.70	0.68	1.51
Tb	0.34	0.32	0.79	3.92	0.45	0.43	0.37	0.75
Yb	1.40	1.30	4.00	13.55	2.09	1.68	1.56	3.08
Lu	0.209	0.203	0.590	1.914	0.298	0.255	0.257	0.428
Hf	3.77	6.52	6.86	18.95	8.02	7.01	6.60	11.13
Ta	0.49	0.53	1.86	3.00	0.64	0.72	0.74	3.88
Th	4.47	3.67	25.15	28.04	5.36	5.77	5.43	14.27
U	2.2	1.2	3.8	4.7	1.5	1.6	1.4	2.6

File name C:\IGPET\TW\ROC

Sample	TW-17	TW-18	TW-19	TW-20	TW-21	TW-22	TW-23	TW-24
Na2O	1.63	1.44	1.75	1.38	1.53	1.45	1.93	1.80
Sc	8.51	8.95	9.62	11.10	10.82	10.21	9.57	9.47
Cr	38	40	48	54	41	41	31	32
FeO	4.37	4.64	4.36	5.03	5.41	5.16	5.07	5.20
Co	5.4	5.7	7.5	8.2	6.4	5.8	6.8	6.8
Zn	73	70	73	78	88	65	75	73
As	9.5	9.5	8.1	8.9	14.6	13.0	11.7	8.8
Br	7.1	7.9	4.7	4.6	4.3	4.5	6.7	6.2
Rb	129	114	125	109	155	140	95	89
Sb	0.9	0.7	0.7	0.6	0.8	0.7	0.6	0.5
Cs	4.7	4.8	4.9	5.5	5.1	4.8	3.7	3.5
Ba	1651	1780	1975	2224	1235	1269	2072	1998
La	55.1	60.1	59.5	65.0	65.6	62.8	57.4	58.1
Ce	93.8	102.5	115.9	117.5	97.6	96.7	115.3	113.9
Nd	51.5	54.6	54.5	56.9	63.0	62.0	57.1	58.2
Sm	10.73	11.34	9.49	10.26	12.87	12.18	9.62	9.52
Eu	1.07	1.15	1.45	1.52	1.51	1.42	1.79	1.69
Tb	1.69	1.69	1.15	1.25	2.06	1.99	1.16	1.13
Yb	7.94	7.79	3.72	4.22	9.74	8.66	3.96	3.92
Lu	1.119	1.110	0.531	0.598	1.349	1.195	0.549	0.560
Hf	13.83	14.25	9.02	9.81	18.43	15.67	11.75	11.78
Ta	2.39	2.52	1.97	2.28	2.63	2.26	2.55	2.37
Th	18.46	21.09	21.40	21.38	22.38	20.40	1.62	20.19
U	3.2	3.2	3.0	3.6	4.9	3.6	2.9	2.8

File name C:\IGPET\TW\ROC

Sample	TW-25	TW-26	TW-27	TW-28	TW-29	TW-30	TW-31	TW-32
Na2O	2.12	1.90	1.67	1.52	1.47	1.33	2.26	2.12
Sc	11.67	10.72	11.80	12.50	10.86	11.64	9.00	9.29
Cr	47	45	54	58	53	57	32	32
FeO	5.14	4.84	5.17	5.53	4.70	4.96	5.24	5.63
Co	8.6	8.7	8.7	9.3	10.2	11.0	10.3	9.1
Zn	72	57	72	86	71	80	90	93
As	5.0	5.0	6.7	0.0	7.2	7.7	13.2	13.7
Br	7.3	7.0	6.1	8.0	9.1	8.7	5.3	5.5
Rb	118	114	125	119	121	113	92	89
Sb	0.6	0.6	0.7	0.8	0.6	0.7	0.8	0.8
Cs	4.9	4.7	4.9	5.0	4.9	5.0	5.1	4.9
Ba	1993	1812	1352	1330	1336	1324	1652	1524
La	47.2	47.9	43.0	50.2	49.5	45.0	57.9	58.0
Ce	82.4	84.2	80.0	91.3	92.5	83.7	101.3	95.5
Nd	45.1	40.8	34.2	39.4	0.0	37.6	42.6	44.9
Sm	7.31	8.14	6.93	7.90	9.16	7.62	8.19	8.12
Eu	1.27	1.26	1.19	1.28	1.63	1.37	1.73	1.69
Tb	1.00	1.01	0.88	1.04	1.20	1.01	0.92	0.93
Yb	3.51	3.62	3.13	3.63	4.07	3.59	2.82	3.02
Lu	0.514	0.513	0.454	0.521	0.586	0.510	0.414	0.451
Hf	9.76	10.23	9.18	9.63	8.92	9.97	8.12	10.86
Ta	2.00	2.14	1.98	2.15	1.84	1.66	3.50	3.45
Th	21.12	19.19	19.70	20.76	90.10	15.20	19.74	18.87
U	2.6	2.4	2.5	2.7	5.6	2.6	2.9	2.6

File name C:\IGPET\TW\ROC

Sample	TW-33	TW-34	TW-35	TW-36	TW-37	TW-38	TW-39	TW-40
Na2O	2.29	2.10	2.37	1.74	1.82	1.71	1.74	1.78
Sc	9.16	8.99	9.32	9.30	6.65	7.45	9.23	9.21
Cr	32	32	32	34	18	18	30	29
FeO	5.37	5.30	5.43	5.57	3.79	4.41	5.25	5.23
Co	9.9	9.5	10.2	10.4	5.9	6.8	5.8	5.7
Zn	94	97	93	96	60	72	75	76
As	13.1	10.3	12.8	7.0	5.9	6.6	10.0	10.6
Br	5.7	4.5	8.0	0.0	4.4	5.1	5.2	5.8
Rb	97	87	95	94	122	119	123	125
Sb	0.8	0.8	0.9	0.9	0.5	0.6	0.6	0.6
Cs	5.3	5.1	5.7	5.4	3.2	3.5	4.6	4.5
Ba	1638	1807	1884	1780	1394	1441	1679	1641
La	59.6	57.5	59.1	58.0	61.8	69.1	54.1	57.8
Ce	96.0	96.9	100.5	94.5	86.5	96.8	94.1	100.6
Nd	42.1	40.5	40.5	40.6	45.4	47.1	43.9	45.7
Sm	8.19	8.14	8.16	7.93	8.68	9.19	8.83	9.27
Eu	1.70	1.68	1.69	1.62	1.40	1.54	1.62	1.65
Tb	0.96	0.95	0.97	0.93	0.98	1.01	1.07	1.11
Yb	2.91	2.90	3.00	2.92	3.04	3.27	3.77	3.72
Lu	0.398	0.409	0.439	0.427	0.457	0.484	0.552	0.571
Hf	8.24	9.74	9.27	10.16	9.79	9.29	10.50	9.16
Ta	3.25	3.15	3.24	3.20	2.34	2.99	2.19	2.37
Th	20.86	19.42	18.02	23.00	26.92	28.33	20.08	23.69
U	2.8	2.7	2.8	3.1	3.1	3.1	2.8	3.1

File name C:\IGPET\TW\ROC

Sample	TW-41	TW-42	TW-43	TW-44	TW-45	TW-46	TW-47	TW-48
Na2O	1.65	1.73	2.09	2.05	1.22	0.00	1.85	1.64
Sc	9.13	9.44	8.70	8.57	11.54	0.00	8.33	9.00
Cr	29	30	23	22	42	0	34	36
FeO	5.18	5.40	5.11	5.13	5.61	0.00	4.24	4.54
Co	5.7	5.8	5.0	5.1	10.9	0.0	5.8	6.3
Zn	80	72	79	69	94	0	67	74
As	9.4	10.2	8.5	9.5	7.3	0.0	10.7	11.5
Br	5.1	5.5	4.4	4.5	4.7	0.0	4.8	5.6
Rb	117	115	112	111	109	0	176	153
Sb	0.6	0.6	0.6	0.5	0.7	0.0	0.7	0.8
Cs	4.1	4.4	3.2	3.3	6.8	0.0	4.2	4.3
Ba	1842	1862	1696	1706	1309	0	1068	1103
La	56.6	56.1	61.4	64.3	47.2	0.0	72.5	71.2
Ce	99.9	102.4	114.6	114.5	88.1	0.0	123.8	126.0
Nd	45.9	46.6	51.5	52.5	39.1	0.0	63.9	62.6
Sm	9.02	9.49	9.78	9.80	7.45	0.00	12.73	13.41
Eu	1.63	1.75	1.77	1.71	1.32	0.00	1.13	1.20
Tb	1.10	1.15	1.17	1.13	0.89	0.00	2.06	2.39
Yb	3.68	4.01	3.99	3.87	3.00	0.00	11.53	12.62
Lu	0.523	0.597	0.570	0.566	0.434	0.000	1.641	1.723
Hf	9.08	13.09	12.32	12.65	6.60	0.00	16.63	15.01
Ta	2.20	2.40	2.73	2.69	2.06	0.00	2.21	3.64
Th	21.03	29.57	22.65	23.76	22.24	0.00	30.80	27.10
U	2.9	3.5	3.1	3.3	3.3	0.0	4.8	5.0

File name C:\IGPET\TW\ROC

Sample	TW-49
Na2O	1.53
Sc	10.13
Cr	39
FeO	3.58
Co	9.9
Zn	66
As	6.5
Br	2.9
Rb	108
Sb	0.8
Cs	9.7
Ba	622
La	34.0
Ce	64.6
Nd	25.4
Sm	5.45
Eu	1.13
Tb	0.69
Yb	2.30
Lu	0.337
Hf	4.54
Ta	0.84
Th	9.92
U	2.7

File name C:\IGPET\MB3\ROC

Sample		MB3-1	MB3-2	MB3-3	MB3-4
FeO	wt%	3.92	4.09	3.99	4.14
Na2O		1.39	2.30	2.42	2.93
Sc	ppm	6.95	8.79	8.66	9.28
Cr		36	27	27	37
Co		10.7	7.6	5.8	9.6
Zn		68	81	68	89
As		8.7	3.9	3.9	6.1
Br		7.1	2.5	2.6	1.4
Rb		116	90	90	87
Sb		0.7	0.3	0.3	0.7
Cs		4.58	2.90	3.03	6.69
Ba		427	961	881	856
La		46.6	84.4	79.7	34.9
Ce		175.0	176.2	160.8	70.6
Nd		47.0	74.0	78.0	29.3
Sm		10.16	14.28	15.07	5.47
Eu		1.11	2.22	2.22	1.26
Tb		1.70	1.79	1.96	0.67
Yb		8.71	6.18	6.40	2.10
Lu		1.198	0.895	0.881	0.313
Hf		20.00	20.50	15.92	4.90
Ta		2.03	3.46	3.17	0.86
Th		18.75	18.36	17.21	10.10
U		4.2	3.9	3.1	3.4

Appendix C
Macrobotanical Data

FLOTATION ANALYSIS FROM 6 SITES FROM THE TOBIN WELLS PROJECT, FORT BLISS, TEXAS

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Quaternary Services, Technical Report 94-021
JUNE 1994

INTRODUCTION

A total of 16 flotation samples from sites FB 12400, FB 12427, FB 12429, FB 12432, FB 12441, FB 12444, and FB 12445 were submitted for analysis to Quaternary Services. These sites were excavated by personnel of Fort Bliss Directorate of Environment. No additional site information was provided, and I have not personally visited the site areas.

METHODS AND MATERIALS

The physical flotation using water separation, of all samples was conducted by Fort Bliss personnel. The initial volume of material was measured and recorded and then screened to remove the larger particles. The screened material was picked for possible radiocarbon age determination and also for possible species identification. The material passing through this screen was placed in a plastic bucket filled with tap water. The heavier fraction was stirred and the light material removed using a wire strainer covered with Organza cloth. This procedure was repeated a minimum of three (3) times or until no additional light fraction was released. When all the light organic fraction had been collected, the organza cloth containing the light fraction was tied and labelled and set in a drying rack to air dry. After drying, the light fraction was placed in labelled coin envelopes and sent for analysis to Quaternary Services.

Upon receipt of the samples, the amount of light fraction present was measured (volume) and recorded. The contents were examined using a Meiji stereoscopic zoom microscope (7X-45X magnification). In some cases the material was passed through a geologic screen series in order to consolidate similar sized materials. Since most of the coin envelopes were quite full, after completion of the analysis, the material was placed in plastic zip-loc bags and returned to Fort Bliss for curation. Identifications were based on comparisons with modern reference specimens contained at Quaternary Services and the Biology Department herbarium at the University of New Mexico (where warranted).

Results and Discussion

The results of the flotation analysis are presented in Table 1. No seed remains were recovered from any of the samples. The majority of the samples were composed of uncharred material only. As noted on the bags, the larger pieces of charcoal had been previously removed and thus it is not surprising as to the condiiton of the samples.

Flotation Results from Tobin Wells Project				
Site	Bag Number	Feature	Volume	Identification
12400	G14, G48, G50	1	80 ml	ucpd, CF, >95% uc
12400	G16	2	35 ml	ucpd, CF
12427	G13, G14, G15, G74	1	70 ml	ucpd, CF, l
12429	G286, G327	2	80 ml	ucpd,CF
12429	G288	3	50 ml	ucpd, CF
12429	G291, G332	4	100ml	ucpd, CF, >95%uc
12429	G331	6	10 ml	ucpd, CF, >95%uc
12429	G334	5	10 ml	ucpd, CF
12432	G102, G108	2	88 ml	ucpd, CF
12432	G110	1	80 ml	ucpd, CF
12441	G117	2	190 ml	ucpd, CF, l, >95%uc
12441	G132, G133	3	80 ml	ucpd, CF
12441	G127, G235, G236	1	90 ml	ucpd, CF, l, >95%uc
12444	G11, G12	1	98 ml	ucpd, CF, l, >95%uc
12445	G19, G20	1	25 ml	ucpd, CF, l, >80%uc
12445	G29	2	80 ml	ucpd, CF